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U. S. ARMY TEST AND EVALUATION COMMAND
ENVIRONMENTAL TEST PROCEDURE

DESERT ENVIRONMENTAL TEST OF AMMUNITION AND EXPLOSIVES

1. OBJECTIVE

The objective of the procedures outlined in this MTP is to provide a means of evaluating the capability of ammunition and explosives to function effectively against all known conditions in the desert which might have significant effects on the performance characteristics of the ammunition.

2. BACKGROUND

Each item developed and produced for the Army must perform satisfactorily in any of the world's environments. Some of the most extreme natural environments are found in the desert.

Ammunition and Explosives stored, transported, and used in the desert experience conditions and stresses peculiar to this type of environment. These conditions and stresses arising from them are the results of the climatic and geophysical environments of a desert. For a detailed discussion on the terrain and its associated features, see MTP 10-1-003. Because of such unique stresses, the results of these types of desert environmental factors affect ammunition and explosives in such a way that it is not always possible to predict their performances from the results of tests conducted in other climates or simulated hot-dry environments. These desert field tests are therefore indispensable for evaluation of the suitability of an item intended for use in desert areas of the world.

3. REQUIRED EQUIPMENT

a. Vehicles (cargo).
b. General and special tools and ancillary items required for inspection, repairs or maintenance on the test item.
c. Test equipment (to monitor environmental conditions and to test ammunition and explosives).
d. Still and motion picture cameras with associated photographic equipment (black and white or color).
e. Meteorological support instrumentation.

4. REFERENCES

A. Roffee, Barton H., Test Capabilities at Yuma Proving Ground, 2nd Ed., Headquarters, Yuma Proving Ground, Sept. '67 (AD No. 824 1162).
B. AR 70-8, Human Factors and Social Sciences Research.
C. AR 70-10, Army Material Testing.
D. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
E. AR 705-5, Army Research and Development.

F. AR 750-6, Maintenance Support Planning.
G. USATECOM Regulation 350-6, Training in New or Modified Equipment and Training Devices.
H. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
I. USATECOM Regulation 70-23, Equipment Performance Reports (EPRs).
J. MIL-STD 105D, Sampling Procedures and Tables for Inspection by Attributes.
K. MIL-STD 619B, United Soil Classification Systems for Roads, Airfields, Embankments and Foundations
L. MIL-STD 1165, Glossary of Environmental Terms (Terrestial).
M. AMCP 706-112, Planning and Analysis of Comparative Experiments, April 1965.
N. AMCP 706-114, Experimental Statistics, Section 5: Tables.
O. TIB ROB-67-02, Sampling of Attributes; Binominal Distribution (Confidence Levels), June 1967.
P. FM 31-25, Desert Operations.
Q. MTP 3-1-004, Artillery Range and Ballistic Match Firings (Indirect Fire).
R. MTP 3-2-030, Grenade Launcher.
S. MTP 3-2-810, Weapon Pressure Measurement.
T. MTP 3-4-001, Desert Environmental Test of Armament and Individual Weapons.
U. MTP 4-1-003, Order of Functioning.
V. MTP 4-2-016, Ammunition, Small Arms.
W. MTP 4-2-045, Demolition Equipment, Explosive Initiating, Elec. and Non-Elec.
X. MTP 4-2-501, Projectiles.
Y. MTP 4-2-509, Airdrop Capability of Materiel (Ammunition).
Z. MTP 4-2-802, Measurement of Projectile Seating.
AA. MTP 4-2-805, Projectile Velocity Measurements.
AB. MTP 4-2-807, Fuze Functioning Time-Superquick Fuzes.
AC. MTP 4-2-808, Fuze Functioning Time-Airburst Fuzes.
AD. MTP 4-2-829, Vertical Target Accuracy and Dispersion.
AE. MTP 4-3-514, Safety Hazards.
AF. MTP 5-4-001, Desert Environmental Test of Missile and Rocket Systems.
AG. MTP 7-4-003, Desert Environmental Test of Aircraft Armament.
AH. MTP 8-4-001, Desert Environmental Test of Chemical, Biological and Radiological Equipment.
AI. MTP 10-1-003, Desert Terrain.
AJ. MTP 10-3-500, Pre-operational Inspection and Physical Characteristics.

5. SCOPE

5.1 SUMMARY

This MTP describes in general terms the preparation, conduct,

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recording and reporting methods to be used for desert environmental testing of ammunition and explosives. Included within this heading are artillery and small arms ammunition, ammunition components, demolition materiels, mines, pyrotechnics, and ignition systems.

These test procedures will assist in the evaluation of the primary technical characteristics of an item as affected by a desert environment. They are designed to obtain quantitative data employing identifiable, and if possible, controllable and reproducible parameters. They will reveal deficiencies or shortcomings and will usually identify the causes of deficiencies.

The specific tests to be performed, along with their intended objectives, are listed below:

a. Inspection/Physical Characteristics - The objective of this subtest is to determine:

1) The overall physical condition of the test items arriving at the testing installation.
2) If the test items are complete. This includes ancillary equipment and maintenance packages.
3) If the test items are correctly assembled, properly labeled, and ready for test.

b. Control Functioning Test - The objective of this subtest is to:

1) Determine if the control test items have been subjected to any pre-receipt exposure, rendering them unfit for test.
2) Establish a basis for comparing the performance of rounds exposed to the desert with unexposed rounds.

c. Exposure - The objective of this subtest is to determine the capability of test items to withstand exposure to the desert climatic and terrain environments during transport and storage.

d. Functioning - The objective of this subtest is to determine the capability of the test items to function satisfactorily when employed under actual tactical conditions in conjunction with associated equipment in a desert environment.

e. Security from Detection - The objective of this subtest is to determine the capability of the test items to avoid detection when emplaced in typical desert (field) terrain.

f. Maintenance - The objective of this subtest is to determine the maintenance requirements for the test items in a desert (field) environment.

g. Safety - The objective of this subtest is to determine if the test items are safe for use in a desert (field) environment.

5.2 LIMITATIONS

This MTP deals with field testing and no specific instructions are provided for performing tests in simulated environments or other induced hot-dry conditions.

The material in this MTP does not constitute complete or detailed test plans but a test plan for desert environmental testing of ammunition and explosive items may be developed from the general procedures outlined in this MTP.

Supplementary information may be obtained from MTP 3-4-001, MTP 4-2-509, MTP 5-4-001, MTP 7-4-003, and MTP 8-4-001.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Select test equipment ideally having an accuracy of at least ten times greater than that of the function to be measured.

b. Record the following information:

1) Nomenclature, serial number(s), and manufacturer's name and function of the test item(s) under test.
2) Nomenclature, serial number(s), accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the tests.
3) Date of manufacture of test item.

c. Ensure that all test personnel are familiar with the required technical and operational characteristics of the item under test, such as stipulated in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), and Technical Characteristics (TC), and record this criteria in the test plan.

d. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout the test conduct.

e. Prepare record forms for systematic entry of data, chronology tests, and analysis in final evaluation.

f. Review all instructional material issued with the test item by the manufacturer, contractor, or government, as well as reports of previous tests conducted on the same type of equipment, and familiarize all test personnel with available references.

g. Record the grade, MOS, background, and training of all test personnel and ensure that all personnel receive new equipment training (NET).

h. Verify that test facilities, equipment and accessories are available, operational and properly calibrated as applicable. Power sources shall be checked to ensure correct outputs.

i. Record the prevailing meteorological conditions as required, during test conduct, to include:

1) Temperature
2) Humidity, relative or absolute.
3) Temperature gradient
4) Atmospheric pressure
5) Precipitation
6) Solar radiation

7) Wind velocity

j. Develop and prepare a test item sample size plan.

k. Select from each test lot a random sample of test and control items. The number of items selected shall be determined on a statistical basis using the planning chart shown in Figure 1, and the method of selection described in Appendix A.

l. Store all test and control items in protected isothermic storage (70° ± 5°) until start of exposure tests.

m. Prior to initial inspection, test items shall be identified in accordance with Appendix A, paragraph 3.4, as follows:

1) Small arms ammunition, 20 mm and smaller
2) Ammunition, larger than 20 mm and other items

n. Instrument at least one test item for each exposure made, Reference Figure 1, columns a through p.

NOTE: An item may be instrumented to furnish both transportation and storage data.

o. Ensure that the transporting vehicles are properly instrumented to provide the appropriate data.

6.2 TEST CONDUCT

NOTE: A detailed discussion of desert test conditions is contained in MTP 10-1-003.

6.2.1 Inspection/Physical Characteristics

NOTE: Unless otherwise defined by Technical Characteristics (TC's), QMR's, SDR's, the following inspection sequence should be performed (Reference MTP 10-3-500).

a. Select identification numbers before inspection.

b. Mark the overpacks with the identifying numbers of their enclosed test items.

c. Uncrate the overpacks in accordance with MTP 10-3-500.

d. Transfer the test identifying numbers to the individual containers (if the test items are not packed in individual containers, proceed to next step, e).

e. Subject all test and control items, components and accessories to a thorough visual inspection to determine the existence of any damage or deficiency in accordance with applicable Table of Appendix B. Photograph as applicable.

f. Remove the test item from the individual container and mark the item with an identifying test number.

g. Correct as many deficiencies as possible. If a critical defect cannot be remedied, remove the item from test.

h. Using the test items which are to be instrumented, determine the

SCHEDULING TABLE - EXPOSURE TESTS

Figure - 1

following physical characteristics as applicable:

1) Exterior dimensions such as length, width, diameter, etc.
2) Interior dimensions related to component fittings, such as thread diameters, cavity depth, etc.
3) Weights of the test item, and major components.
4) Color of test item including presence of reflecting or shiny surfaces.

NOTE: Consideration should be given at this time to taking other physical measurements which may assist in evaluation of the test items. Such measurements include center of gravity, and moments of inertia.

6.2.2 Control Functioning Test

a. Select a representative sample of test items to serve as control items, and subject a control group to functional testing as outlined in paragraph 6.2.4, except the control items shall be kept in isothermic storage (70° ± 5°F) until immediately prior to firing. The same data shall be taken.

b. Evaluate the data obtained for signs of defective performance and retain the data for reduction and presentation with the remainder of the functioning data (paragraph 6.2.4).

NOTE: The use of control rounds plays an important role in the evaluation of test results by providing a basis for comparison of results. Furthermore, malperformance of control rounds will prove damage to test items before receipt by the proving ground. If such damage is detected before the test exposure cycle starts, considerable time and expense can be saved. Therefore, one control group shall be functioned prior to the start of exposure testing.

6.2.3 Exposure

NOTE: 1. The procedures described below are based on a "stockpile-to-target" matrix (Figure 2). The matrix is originated at the "communication zone depot" level. Prior to this point, it is assumed ammunition and explosive items will be maintained in a temperate environment while in CONUS, and then a maritime environment. These environments are beyond the scope of this procedure.
2. Munitions may be affected by the various terrain environments encountered during exposure and functioning subtests. Appendix C summarizes the terrain parameters involved. (See MTP 10-1-003 for additional data.)

6.2.3.1 Road Transportation

a. Instrument the test item(s) to obtain the following information:

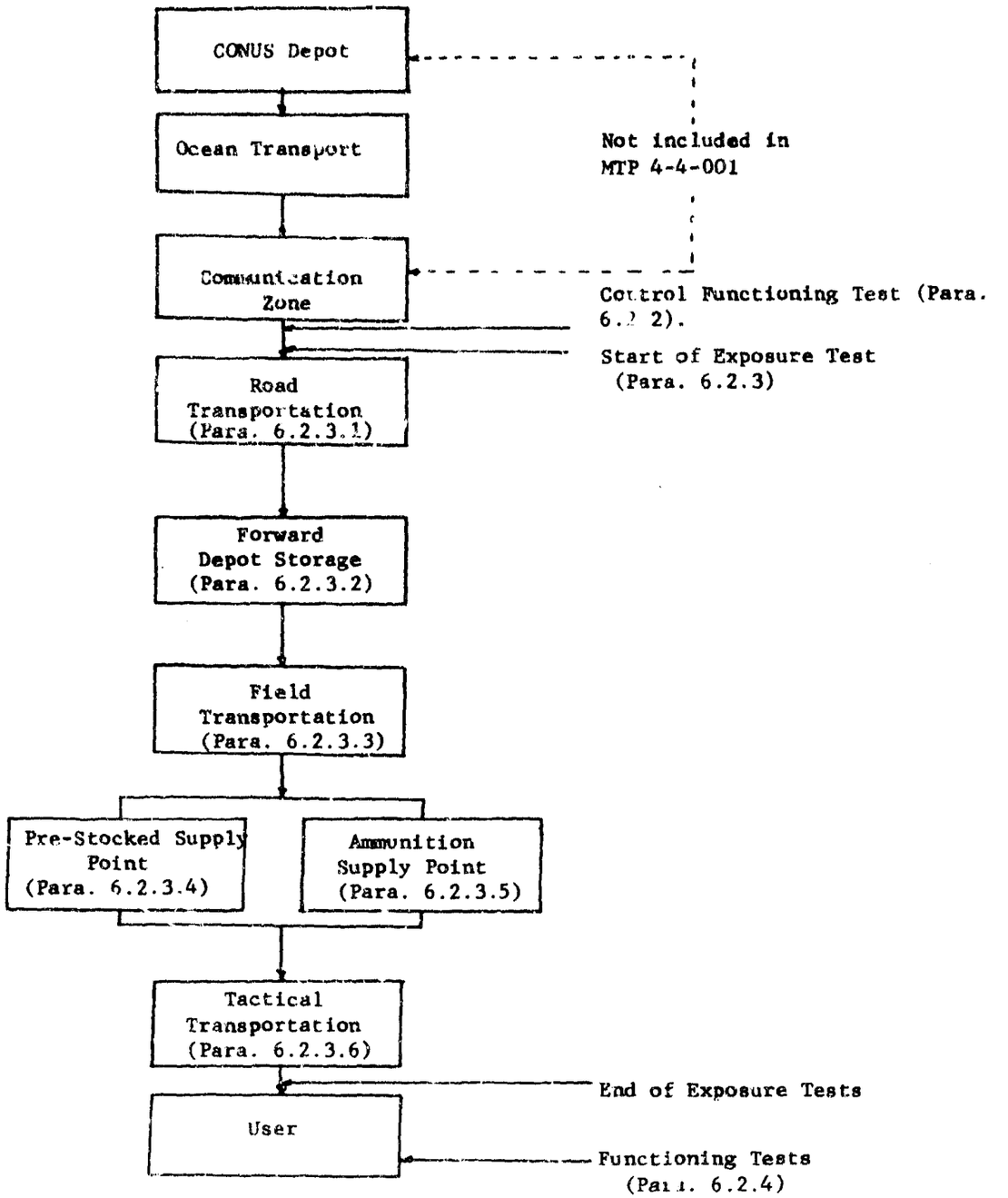


Figure 2. Stockpile-to-Use-Flow of Ammunition and Explosives.

1) Average test item skin temperatures
2) Temperature of critical components
3) Temperature of explosive and/or propellant
4) Shock environment to which the test item is exposed

b. Package the test item(s) in accordance with applicable instructions, and load onto the cargo transport vehicle. If necessary, weights and containers shall be added to make up a full load.

c. Maintain a critical observation of handling experiences occurring during the various sequences of vehicle loading, transporting, unloading, unpacking, storage, and emplacement. Evaluate circumstances in the handling process which have significant probability of resulting in damage or deterioration.

d. Transport the test items from the communications zone to the forward depot storage area. The transportation shall include travel over 150 miles on paved roads (or test courses), and 450 miles on secondary roads (or a course similar to the Yuma Proving Ground gravel course).

e. Unload the test item(s) from the transport vehicle and remove from the container(s), if applicable.

f. Inspect the test item(s) in accordance with Appendix B. CAUTION: Use extreme care if explosives appear deteriorated or discolored. Only qualified personnel shall handle such items.

g. Remove item(s) damaged during transportation which will render them unsatisfactory for firing. Hold for examination to attempt to pinpoint the particular subtest, or phase thereof, which may cause a failure.

6.2.3.2 Forward Depot Storage

a. Instrument the test item(s) to obtain the following information (thermocouple locations shall be as required to measure temperatures for each storage mode):

1) Overpack skin temperature
2) Container skin temperature
3) Container interior air temperature
4) Maximum test item skin temperature
5) Average test item skin temperature
6) Temperatures of critical components
7) Temperature of propellant and/or explosive component

b. Place the test item(s) in storage.

NOTE: 1. Items shall be stored in their shipping containers. If specified half shall be in their overpacks. Adequate dunnage, ventilation, and cover shall be supplied.
2. The storage period shall be a minimum of 21 days, with at least 10 days having an air temperature in excess of 105°F for a duration of 4 hours.
3. Vehicular traffic shall be routed upwind of the storage area, with a minimum of 200 vehicles passing during the storage period. Thick (6 to 12 in.) dust deposits shall

be maintained on adjoining roads.

c. Photograph the storage site and instrumentation setup.

d. Upon removal from storage prior to field transport, perform the following on the test item:

1) Visual inspection for signs of damage.
2) Basic operational checks to verify satisfactory operation of the test item.

6.2.3.3 Field Transportation

The field transportation subtest shall be conducted as outlined in paragraph 6.2.3.1, except transportation mileage shall consist of 70 miles over the Yuma Proving Ground Desert March Trail (or its equivalent). Vehicle speeds shall be as high as can be obtained without jeopardizing the safety of the crew.

6.2.3.4 Prestocked Supply Point

NOTE: This is an optional storage test. It should be included if the test item is planned to be used operationally in such an exposure, e.g., special forces munitions.

Repeat the procedures outlined in paragraph 6.2.3.2, except:

a. Test items shall be concealed in a tactically realistic storage site (see FM 31-25).

b. Items shall be stored in their shipping containers (if provided) with and without overpack (see Figure 1), and consistent with normal packaging modes.

c. Items shall either be directly on the ground, or palletized (or otherwise kept from direct contact with the ground). Camouflage, natural or artificial, shall be provided.

d. The storage period shall be for at least 28 days, with the following minimums:

1) Ten days with air temperatures of at least 105°F for a duration of 4 hours, and
2) Twenty days with ground temperatures of at least 130°F for a duration of 4 hours; or 5 days with ground temperatures of at least 140°F for a duration of 3 hours.

e. The storage site shall be remote from regular vehicular or mounted traffic.

6.2.3.5 Ammunition Supply Point (ASP)

a. Instrument the test items and place in a simulated ASP as outlined in paragraph 6.2.3.2.

NOTE: 1. The storage period shall be a total of 3,780 degree hours above 90°F.
2. Exposure combinations which meet 1, above are shown in order of decreasing severity in Appendix D.
3. If the climatic conditions are such that the more severe conditions will be reached with a short extension of the exposure time, the project engineer should endeavor to change the overall schedule to allow such an extension.

b. When a total of 3,780 degree-hours exposure above 90°F has been reached, remove the items from storage and subject them to visual inspection and operational checks as outlined in paragraph 6.2.3.2.

6.2.3.6 Tactical Transportation

a. Instrument the test items as outlined in paragraph 6.2.3.1, and package in accordance with applicable instructions.

b. Divide the test items as shown in Figure 1, and load on vehicles which are organic to the using organization and operated by the using organization.

NOTE: 1. This subtest varies according to type of mission or mode of transport. The types include:

a.- Light tactical vehicle transporter, such as small arms ammunition, mortar rounds, light and medium artillery (towed), etc.
b.- Emplaced munitions, such as mines, demolitions, some pyrotechnics, etc.
c.- Combat vehicle munitions, such as ammunition for tanks and other self-propelled weapons.

2. Test type A and B shall be transported by light tactical vehicles in their normal mode. If two or more modes are normally employed, the most severe mode will be used for this test. Type C munitions will be carried in the combat vehicle applicable.

c. Transport the test items cross-country over the mileages and terrain components shown in Appendix E.

NOTE: If items may be transported in the field either with or without their individual containers, both modes should be tested during this phase (see Figure 1). Items transported by combat vehicles will include items in their individual containers, and if racks are provided, in racks.

d. Following the transportation phase, unload the items from the vehicles, subject them to inspection as outlined in paragraph 6.2.3.1, and fire or function all items except emplaced munitions. Mines and similar items shall be emplaced and concealed, according to standard practice.

6.2.3.7 Emplacement

NOTE: This subtest applies only to items which will be emplaced for intermittent periods prior to functioning. This includes anti-tank and anti-personnel mines, cratering and demolition charges, trip flares, and the like.

a. Instrument the items under test as outlined in paragraph 6.2.3.2, and package in accordance with applicable instructions.

b. Emplace the items according to their designed use in different types of terrain (see MTP 10-1-003) for a period of at least 30 days, with at least 20 days having ground temperatures in excess of 130°F for 4-hour periods. Test items shall be concealed as required by the emplacement site characteristics (see FM 5-20).

c. At the conclusion of the exposure period, remove the items from the emplacement site(s) and perform inspection and operational checks as outlined in paragraph 6.2.3.2.

6.2.4 Functioning Tests

NOTE: 1. Functioning tests are the primary means of evaluating the effects of the desert environment on the test item. Due to the limited exposure periods, many effects of exposure will not appear during the inspection phase, but will be revealed only during the functioning tests. Consequently, it is mandatory that test personnel adhere as closely as possible to the referenced common test procedures. The proper utilization of control items is also critical.

2. Ammunition and explosives shall be functioned during the hottest part of the day. If possible ambient temperature should exceed 100°F. Ammunition should be exposed, without shade and laying on a ground cloth, for at least two hours prior to loading.

3. Ammunition and explosive items not falling within the following categories shall be tested in accordance with the applicable common engineering test MTP.

a. Inspect all unemplaced test items in accordance with column f of applicable Table, Appendix B. Emplaced munitions shall be left undisturbed except for one test item from each lot (Figure 1). These items shall be exposed, inspected, and replaced.

b. Remove all instrumentation where appropriate, and photograph the test items as applicable.

c. Remove items which have been left in sealed containers to this point, identify, and inspect. Items which are components of major items (i.e., fuzes, primers, cases, etc) will be assembled to major components.

d. Remeasure physical characteristics, as applicable, to determine changes from data acquired during the physical characteristics test (paragraph 6.2.1).

e. Functionally test the ammunition and explosives under test in

accordance with the following:

1) Artillery Ammunition and Components (including Mortars and Recoilless Rifles):

   a) Functioning tests shall be conducted as shown in Appendix F, and in accordance with applicable Commodity MTP (paragraph 4.).
   b) Where fuze functioning tests are specified, impact areas will be selected in accordance with Appendix C. If two or more impact sites are used, test and control rounds should be uniformly divided between the sites.
   c) Control rounds shall be fired intermittently with test rounds, in a constant pattern (i.e., 5 test, - 2 control - 5 test; 1 test - 1 control - 1 test; etc.). This, of course, does not include the control sample fired in the control functioning test (paragraph 6.2.2).
   d) Control items shall be kept in isothermic storage between exposure tests and time of firing.

2) Small Arms Ammunition:

   a) Test of small arms ammunition shall be conducted in accordance with MTP 4-2-016. Cook-off tests should be conducted during the hottest part of the day.
   b) Consideration should be given to use of automatic scoring instrumentation for testing automatic weapons.

3) Demolition and Cratering Charges:

   a) Tests of demolition and crating items shall be conducted in accordance with MTP 4-2-045 and associated MTP's. Tests should be conducted on representative desert terrain (see Appendix C).

4) Emplaced Munitions:

   a) Tests of emplaced munitions such as mines, trip flares, etc. shall be conducted in accordance with the common engineering tests for the specific item.
   b) Emplaced munitions should be functioned in the location of their last exposure (paragraph 6.2.3.7). Disturbances other than application of initiation loads should be avoided. (Only sample of each lot are inspected, see step a, above.)

5) Hand and Rifle Grenades:

   a) Test of grenades shall be conducted in accordance with MTP 3-2-030 and associated MTP's. Terrain type is unessential; however, if tests are conducted over desert

pavement, unconsolidated gravels, or rocky ground, witness boards should be located as necessary to determine effects of secondary fragmentation from rocks or gravel.

6.2.5 Security from Detection (Limited to Emplaced Items)

NOTE: This subtest is limited to emplaced items and may be conducted during the test item's emplacement while undergoing exposure testing as outlined in paragraph 6.2.3.7.

a. Select test sites typical of the world's deserts and providing suitable background conditions, reference MTP 10-1-003 (see Appendix C for landscape types).

b. Site or emplace the test item(s) as applicable.

c. Replace or remove all displaced natural material.

d. Use inert munitions in order to obtain security data in as many terrain environments as applicable, particularly where these terrain conditions are not encountered during the exposure testing.

e. With the test equipment sited or emplaced, remove any sand or other displaced natural material and observe the camouflage and concealment qualities of the test equipment as situated in the following terrain types.

1) Open desert pavement, no cover
2) Rocky or boulder strewn desert, no vegetation
3) Terrain having xerophyte vegetation (non-succulent)
4) Surfaces composed of loose or drifted sand

f. Observe the extent to which blowing sand and surface finish changes associated with abrasion or solar radiation degrade or improve concealment in the above locations.

g. Observe signature effects such as tracks, operational noise, dust clouds, flash smoke, acoustic radiation shadows, etc., during transport, emplacement and actual use of the items under test.

NOTE: Observations concerning camouflage and concealment shall be made with observers positioned at ranges of 500, 1000, and 3000 meters, within line of sight. In cases of test item emplacements greater than 4 sq. yards, observations shall be made from the ground and from elevated positions.

h. Monitor visibility conditions such as the following:

1) Atmospheric clarity (freedom from dust and haze)
2) Sky conditions (cloud cover)
3) Elevation of the sun (time of day and date)

NOTE: Observations taken during this subtest, shall be made utilizing color film and suitable still photographs, if possible.

6.2.6 Maintenance

a. As the test items are removed from storage, off-loaded from transportation, or assembled or loaded for functioning, observe all necessary actions to insure serviceability in accordance with procedures given in MTP 4-3-513. Such actions may include cleaning, removal of accumulated dust, tightening connections and fastenings.

b. Monitor the use of or need for tools or equipment or other supplies to accomplish necessary maintenance.

c. Evaluate the adequacy of all maintenance instructions supplied with the materiel in accordance with AR 705-26.

6.2.7 Safety

a. Prior to committing test items to exposure and performance, review applicable safety statement or safety release and examine all test items for conformity and for presence of other hazardous conditions (refer to MTP 4-3-514).

b. In addition to the above, prepare a safety checklist. It should include safety procedures, precautions, protection and emergency procedures as necessary. Other pertinent information such as the technical information or the technical hazards and safety characteristics, analysis of risks, limitations, and precautions including special techniques and test equipment should be included in the safety checklist.

c. Ensure that all safety procedures are followed throughout the conduct of the test cycle in accordance with the safety plan, and note the observations during each of the subtests given in this MTP.

NOTE: Observations regarding safety shall be observed continually during the entire test cycle. Photographs (black and white or color) shall be made of deficiencies whenever possible.

6.3 TEST DATA

6.3.1 Preparation for Test

Data to be recorded prior to testing shall include but not be limited to:

a. Nomenclature, serial number(s), manufacturer's name, and function of the item(s) under test.

b. Nomenclature, serial number(s), accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the tests.

6.3.2 Test Conduct

In addition to the specific data requirements delineated in subsequent paragraphs, the following items shall be preserved as a part of the test records:

a. Photographs or motion pictures (black and white or color), sketches, charts, graphs, or other pictorial or graphic presentations which will support test results or conclusions.

b. An engineering logbook containing, in chronological order pertinent remarks and observations which would aid in a subsequent analysis of the test data. This information may consist of descriptions of equipment or components, and functions and deficiencies, as well as theoretical estimations, mathematical calculations, test conditions, intermittent or catastrophic failures, test parameters, etc., that were obtained during the test.

c. Instrumentation or measurement system mean error stated accuracy.

6.3.2.1 Inspection/Physical Characteristics

Record the following:

a. Packing - Data in accordance with MTP 10-3-500, Paragraph 6.3.2. Include deficiency codes (Appendix B).

b. Test Item:

1) Test item control numbers.
2) Description of deficiencies or deficiency codes from Appendix B, as applicable, for each test item. Take photographs as required.
3) Adequacy of instructions for unpacking and assembling.
4) Adequacy of tools.
5) Condition, legibility, and adequacy of markings.
6) Time and location of inspection.

c. Maintenance accomplished.

d. Physical characteristics data, to include:

1) Exterior dimensions
2) Interior dimensions
3) Weights of the test item, and major components
4) Color of test item

6.3.2.2 Control Functioning Test

Record observations of malperformance, variation in range, velocity, deflection, and order of functioning.

6.3.2.3 Exposure

Record the following:

a. Description of the test site.

b. Evidences of deterioration, including location on test item, probable effects of deterioration on test item performance, and action taken to alleviate the condition.

c. Deficiencies attributable to exposure.

d. Environmental data at hourly intervals throughout the storage and

emplacement subtests, to include:

1) Ambient air temperature (200 cm above surface; ± 2°F)
2) Ground temperature (5 cm below surface; ± 2°F)
3) Thermocouple readings (ref Para. 6.2.3.1; ± 2°F)
4) Relative humidity (± 5 percent)

e. Environmental data continuously throughout the storage and emplacement subtests, to include:

1) Precipitation (± 0.01 inch)
2) Wind speed (200 cm above surface; ± 5 mph)
3) Wind direction (± 10°)
4) Solar radiation (± 1.0 Gm-Cal/CM2)

f. Transportation data at 15-minute intervals during the subtests, to include:

1) Ambient air temperature (200 cm above surface, ± 2°F).
2) Thermocouple readings (ref Para. 6.2.3.2, a through d, ± °F).
3) Vehicle bed temperature (± 2°F).
4) Vehicle mileage.
5) Shock environment to which the test item is exposed (0-20 g, ± 0.2 g) whether as a count of the times certain levels are exceeded, or a continuous record of the shock at a critical frequency.
6) Course description (nomenclature plus topographic details from maps or surveys sufficient to construct course profiles).
7) Time (± 1 min).
8) Vehicle speed (± 5 mph).

6.3.2.4 Functioning Tests

Record the following:

a. Observations of malperformance, variation in range, velocity, deflection, and order of functioning.
b. Data as required by applicable referenced or common test MTP's.

6.3.2.5 Security from Detection

Record observations of camouflage and concealment qualities of emplaced items to include time of day and sky conditions when observations are made, supported by annotated photographs as applicable.

6.3.2.6 Maintenance

Record the following:

a. Actions taken to ensure serviceability of the item under test.
b. Comments concerning the following aspects of maintenance

1) Ease of performing required maintenance
2) Special tools or skills required
3) Interchangeability of components
4) Adequacy of instructional manuals
5) Photographs as necessary

6.3.2.7 Safety

Record the following:

a. Data as required by applicable portions of MTP 4-3-514.
b. Narrative comments and observations pertaining to unsafe procedures or conditions.

6.4 DATA REDUCTION AND PRESENTATION

a. Processing of raw test data, in general, includes but is not limited to the following steps:

1) Marking test data for identification and correlation
2) Organizing data into tabular and graphical form.
3) Modifying data to correct for nonstandard conditions.
4) Determining the statistical variation of the results in terms of the average value and standard of the particular quantities, the correlation among two or more quantities, etc.
5) Converting units of measured parameters to units of measure as expressed in applicable criteria or test item specifications.

b. It is noted that the test directive (or operation) itself serves to define the types and characteristics of the raw test data, and the ultimate objective of the test program defines the form of the test data desired.
c. Specific instructions for the reduction and presentation of individual subtest data are outlined in subsequent paragraphs.

6.4.1 Inspection/Physical Characteristics

a. Data collected during inspection shall be summarized and presented as follows:

1) Percent total defective

a) Overpacks (based on total number of overpacks)
b) Containers (based on total number of test items)
c) Unassembled parts (based on total number of test items)
d) Assembled parts (based on total number of test items)

2) Percent deficiencies
3) Percent shortcomings
4) Percent test items without any defects

b. For preparation of test reports, refer to USATECOM Reg. 70-23.

c. Data derived from physical characteristics should be presented in tabular form, supplemented by line drawings and photographs.

6.4.2 Control Functioning

a. Data derived from the use of control rounds shall be evaluated to provide a basis for comparison, and to prove damage (if applicable) to the test items before receipt by the proving ground.

b. Control functioning data shall be retained for reduction and presentation with the functioning data.

6.4.3 Exposure

6.4.3.1 Storage and Emplacement

a. Data from thermocouple and meteorological instrumentation shall be summarized graphically for the total test period, as follows:

1) Monthly summaries of ambient air temperature and ground temperature, wind velocity and direction relative humidity, and solar radiation, plotted at 6-hour intervals and marked at daily intervals (see Figure 3).
2) The data in 1) at hourly intervals for a 24-hour period; showing most extreme and mildest days and a representative day during the exposure period (see Figure 4).
3) Test item thermocouple readings, keyed to ambient air temperature and ground temperature and plotted in the manner of the monthly and daily presentations, 1) and 2).

NOTE: Wind measurements are specified at 200 cm as being most applicable for this class of military item. Use of this criteria will correlate directly with ambient temperature measurements. However, if a requirement exists for conformance to AR 705-15 or MIL STD 210 criteria for a wind measured 10 feet above the surface, the following conversions must be made:

Height	Ft	2		5		10		15
	cm		100		299	300	400	
Ratio to 10 ft wind		0.71	0.81	0.89	0.93	1.00	1.05	1.07

b. In addition to the above, presentations will be prepared as required to illustrate circumstances relating to malfunctions or failures attributable to particular environmental stresses.

6.4.3.2 Transportation

a. Climatic data shall be presented as discussed in Paragraph 6.4.3.1.

YUMA PROVING GROUND, YUMA, ARIZONA
METEOROLOGICAL SUMMARY FOR JULY 1967

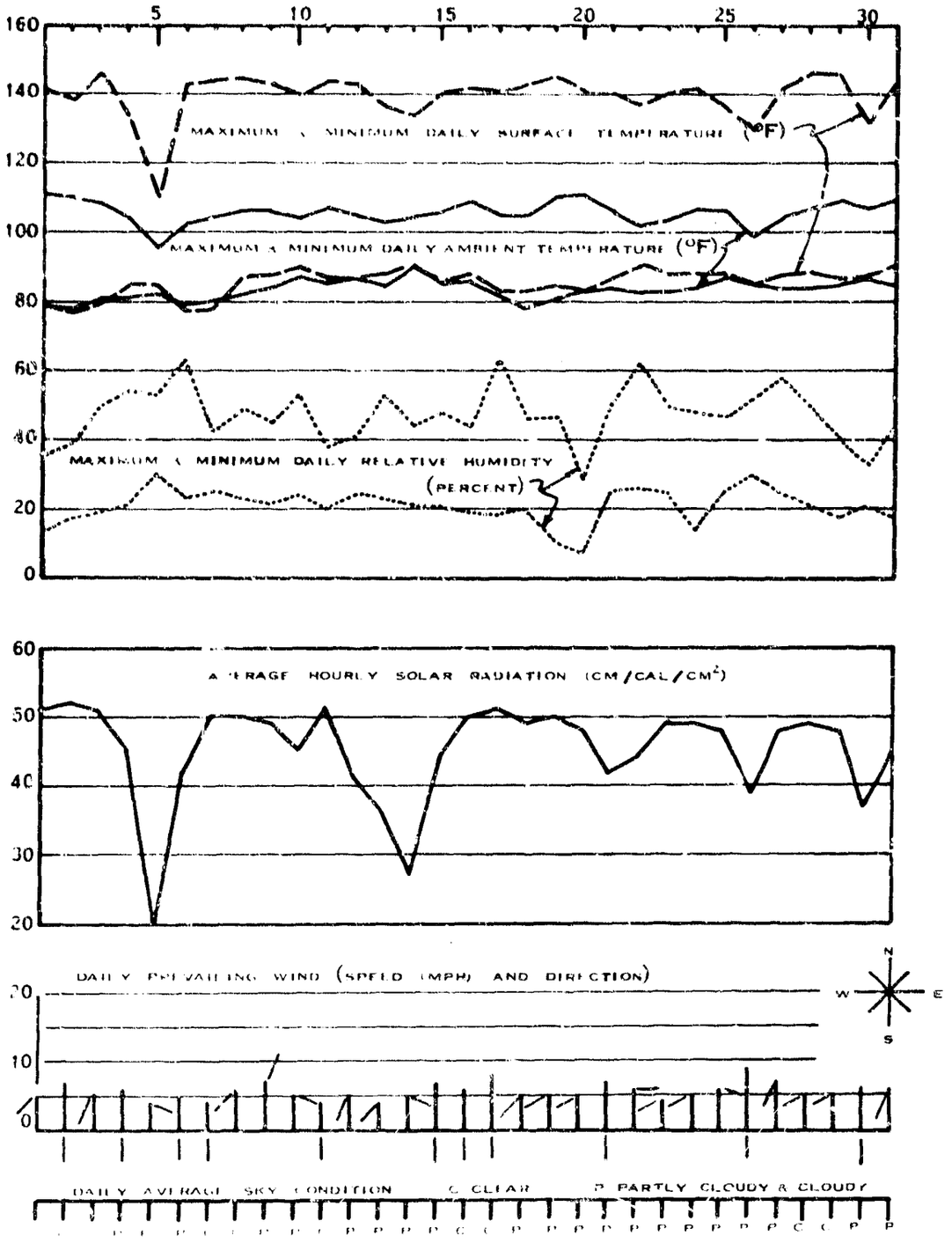


Figure 3. Example of Monthly Meteorological Data Summary.

YUMA PROVING GROUND, YUMA, ARIZONA
METEOROLOGICAL DATA FOR 28 AUGUST 1967
(MONTHLY EXTREME HIGH)

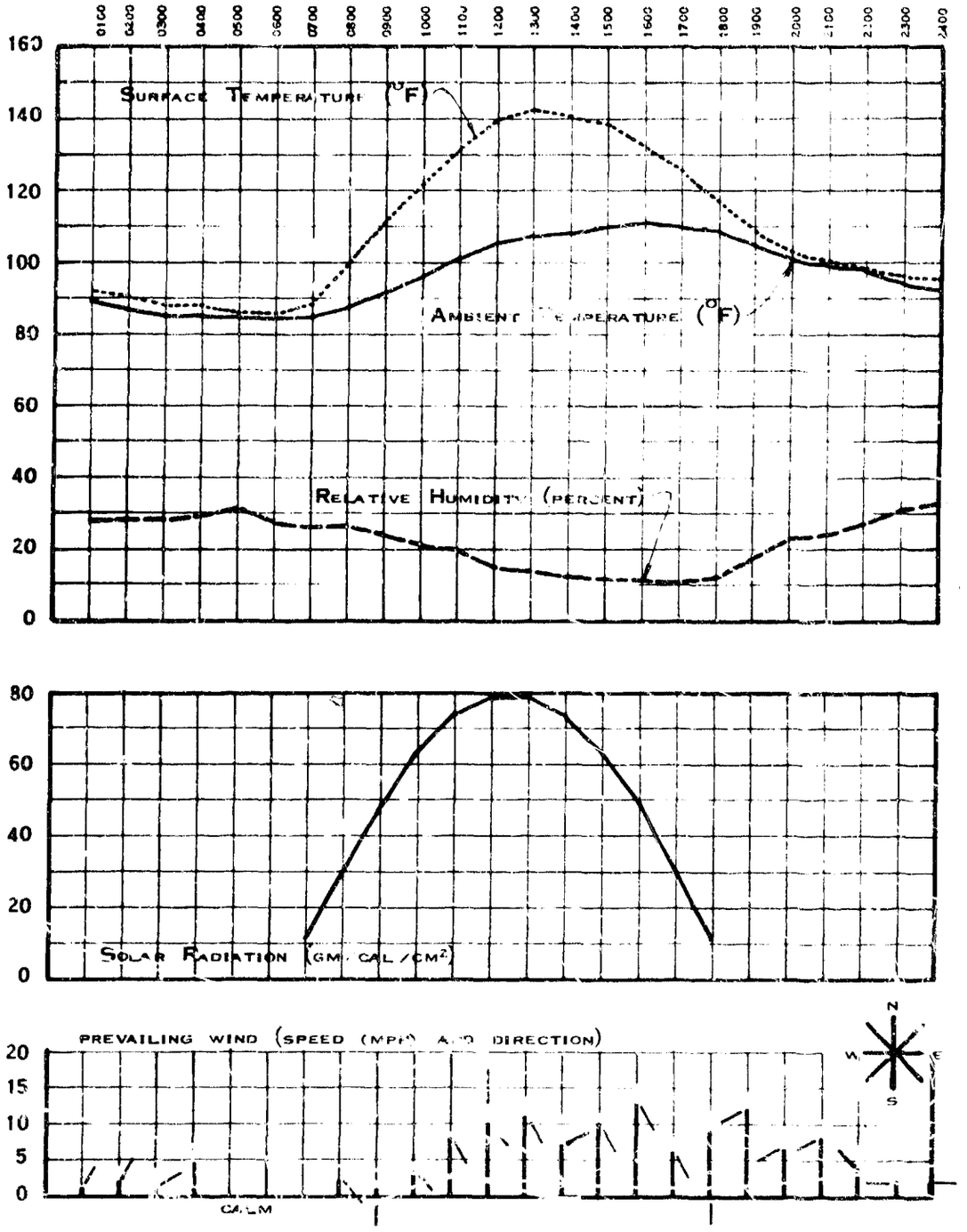


FIGURE 4 EXAMPLE OF DAILY METEOROLOGICAL DATA SUMMARY.

Shock and route data shall be summarized graphically to show:

1) Shock environment, vehicle bed temperature, test item temperature and air temperature as a function of mileage. The traces will be annotated to show time of day and start and finish of the various terrain courses (see Figure 5 for an example of a shock environment display with the shock measured continuously at 100 Hz).
2) Profiles of routes followed (horizontal scale 1:15, 625 if map plotted, 1:10,000 if surveyed; vertical scale 1:120) including annotations for surface conditions (type and micro geometry), slopes, and other significant data (see Figure 6).

b. Handling data shall be reported in narrative form. Utilize motion picture frame illustrations, and graphical summaries as applicable.

6.4.4 Functioning Tests

a. Data from the control functioning tests (Para. 6.2.2) shall be reduced with the functioning data. Results shall be used in a manner suitable for comparison.

b. In addition to data presentations specified in the referenced or common test MTP's, the following data shall be presented:

1) Meteorological data for the days functioning tests are conducted (Ref Para. 6.4.3.1, (a)).
2) Terrain conditions of the functioning site (including subsurface logs, if applicable).
3) Where applicable, dimensions of craters, supplemented by photographs.
4) Where applicable, photographs (color, if necessary) showing obscuration, obturation, or other significant data.

6.4.5 Security from Detection

Present a narrative statement of results of the observations relating to security from detection. Photographic illustrations shall be used as required to substantiate the results.

6.4.6 Maintenance

Observations shall be summarized and presented in narrative form. Where necessary, the narrative shall be supplemented by line drawings and photographs.

6.4.7 Safety

Observations and deficiencies shall be presented in narrative form, supplemented as required by line drawings and photographs.

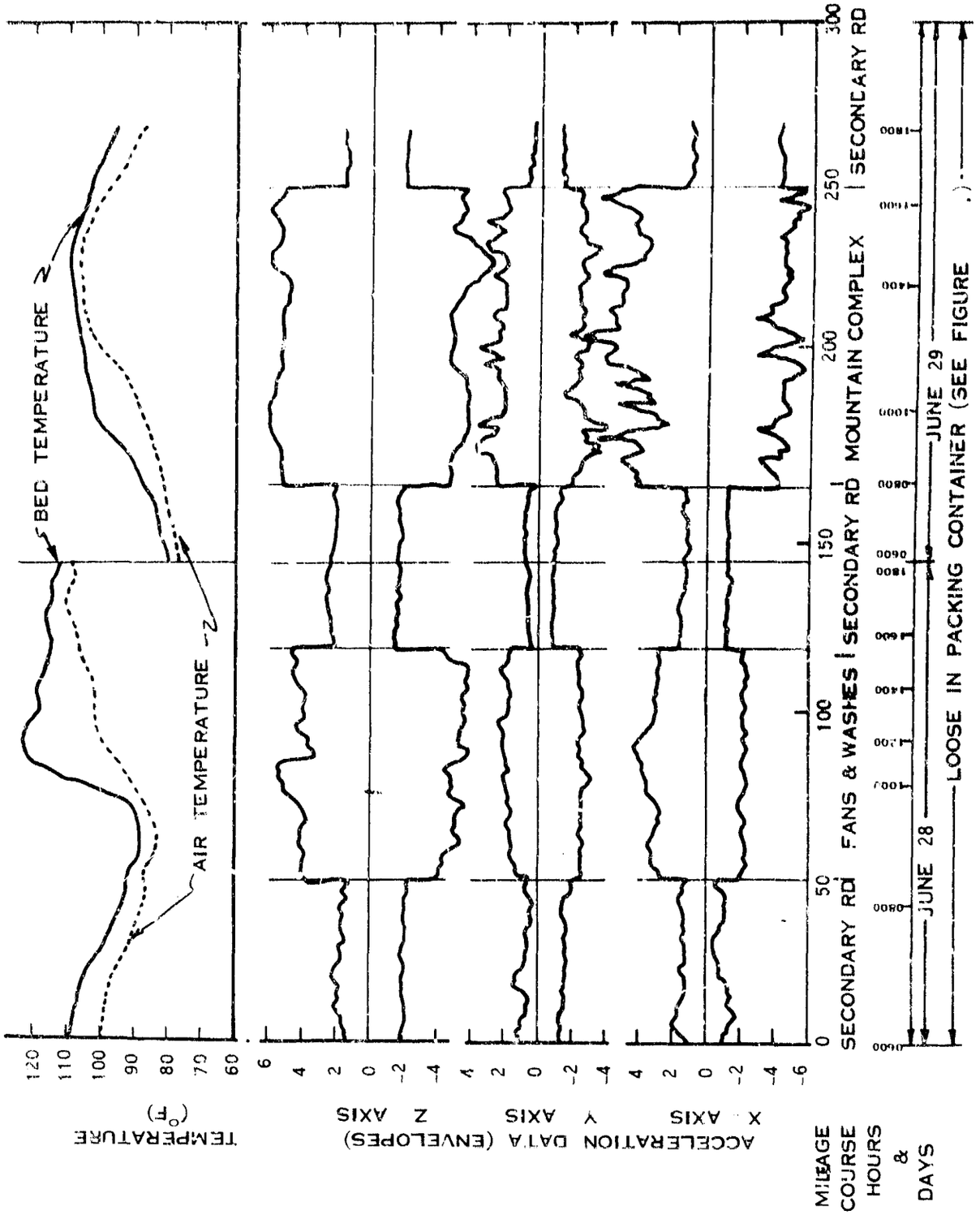
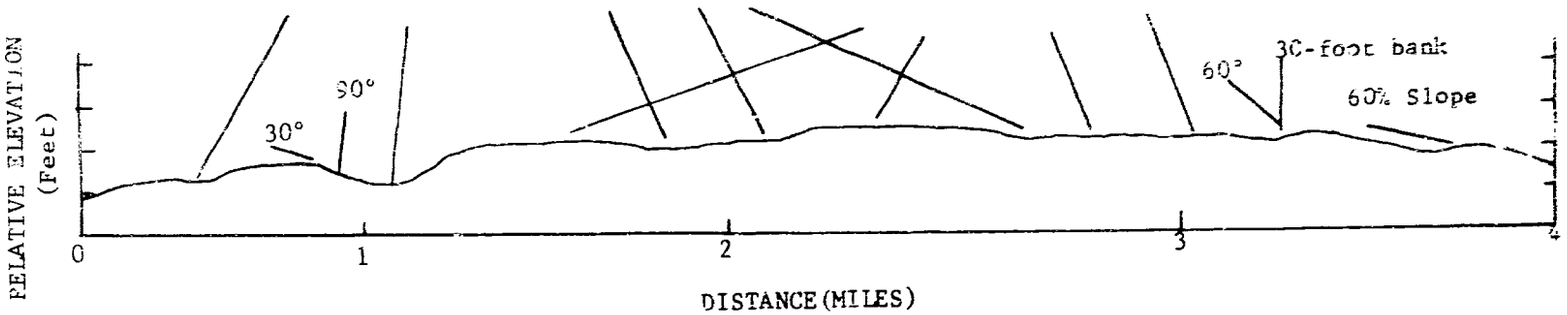


FIGURE 5 EXAMPLE OF TRANSPORTATION TEST ENVIRONMENT SUMMARY.

BANKS, Unless Noted, are from 30° to 50°

WASH BEDS Include 30% Rounded Cobbles (1-inch to 3 inches); 60% Rounded Gravel (1-inch to 1/4 inch With 10% Coarse Sand Uniformly Graded and Sorted, Unconsolidated

FAN SURFACE Include 3-inch to 8-inch Rounded and Angular Boulders, on Matrix of Angular Gravel (80%) and Sand (25%). Matrix Fairly Well Consolidated, and With Medium Boundy Strength



Note: 1. This profile is representative of the route over the fan and wash complex
2. This portion was crossed during transport mileage 175 to 179, 188 to 192, 201 to 205, 211 to 215 and 347 to 351.

Figure 6. Example of Transportation Course Profile

Safety Check List

Clear identification of item

Presence of safety warnings

Adequacy of handling instructions

Safety of handling procedures

Presence of safety devices

Sharp or projecting edges, controls, etc.

Access to arming devices

Replaceable safety devices

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APPENDIX A

SAMPLING PLANS AND CONSIDERATION

1. SCOPE

This Appendix covers the use of "Scheduling Table", Figure 1. The table may be used to:

a. Graphically display the correlation of this MTP with individual test item requirements.
b. Determine the number of test samples required.
c. Determine the number of control samples required.
d. Provide a guide to sample identification and control.
e. Provide a tool for evaluation of test results, including isolation of failures, and determination of effective sample sizes.

2. LIMITATIONS

Long term surveillance or storage tests are beyond the scope of this MTP. Such tests require specialized test plans. Samples required for these tests can be determined by using References J, M, and N.

Test item sample size requirements will be in addition to sample sizes required for the desert environmental test, even if the two tests are combined. If the tests are conducted together, however, the same "total test" control samples can serve both tests. These control samples, of course, will not be air dropped.

3. DISCUSSION

3.1 CORRELATION OF MTP WITH TEST DIRECTIVE

Figure 1 (Scheduling Table) is designed to enable test personnel to integrate the steps of applying test requirements, determination of sample size requirements, and control of individual items during tests. Properly utilized, copies of this tabulation, marked as described below, should be included with the test plan, and with the test SOP. Annotated tabulation will also provide full justification for test item requirements on the List of Materiel Requirements (LMR).

Column Headings

The columnar headings of the tabulation are shown in Figure A-1. The headings are based on the individual subtests in this MTP, and the exposure modes possible within these subtests. The subtests are described in the paragraphs indicated in the title blocks. Optional exposure modes each have a blank box. This box should be marked if the mode will be included in the test plan.

Scheduling Table - Exposure Tests (6.2.3)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
			Field Transport		Pre-stocked Supply Point				Ammo Supply Point		Tactical Transport					
					Container		Exposed				Mud Desert		Gravel Desert		Rock Desert	
	Road Transport	Fwd Depot Storage	w/overpack	w/o/overpack	Pallet	Ground	Pallet	Ground	Container	Exposed	Container	Exposed	Container	Exposed	Container	Exposed
X			☑	☑	☑	☑	☐	☐	☑	☐	☑	☑	☑	☑	☑	☑
1	X	X	X	-	-	-	-	-	X	-	X	-	-	-	-	-
2	X	X	X	-	-	-	-	-	X	-	-	-	X	-	-	-
3	X	X	X	-	-	-	-	-	X	-	-	-	-	-	X	-
4	X	X	X	-	-	-	-	-	-	X	-	X	-	-	-	-
5	X	X	X	-	-	-	-	-	-	X	-	-	-	X	-	-
6	X	X	X	-	-	-	-	-	-	X	-	-	-	-	-	X
7	X	X	X	-	X	-	-	-	-	-	X	-	-	-	-	-
8	X	X	X	-	X	-	-	-	-	-	-	X	-	-	-	-
9	X	X	X	-	X	-	-	-	-	-	-	-	X	-	-	-
10	X	X	X	-	X	-	-	-	-	-	-	-	-	X	-	-

Figure A-1 Columnar Headings For Scheduling Table

Columns (a) and (b) cover Road Transportation, paragraph 6.2.3.1 and Forward Depot Storage, paragraph 6.2.3.2. These subtests should be included in every test plan.

Column (c) indicates field transport of items while in their overpacks. If normal field transport includes carrying the item in their overpacks (e.g., 105-mm howitzer ammunition) this block should be marked. If the item doesn't have an overpack, or is never transported with an overpack, this block should be left blank.

Column (d) indicates field transport of items without overpacks. If normal field transport includes carrying the item without overpack, this block should be marked.

NOTE: Both blocks (c) and (d) may be marked. Both blocks cannot be left blank, as items will always be transported in one of these two modes.

Column (e) indicates the item will be exposed in the Pre-stocked Supply Point Subtest. The item will be in its shipping container on a pallet. Normally this block will be marked. However, if the item does not have a shipping container (e.g. 175-mm ammunition) leave this block, and the block in (f) blank.

Column (f) indicates exposure in the shipping container which is sitting directly on the ground.

Column (g) indicates storage without the shipping container on a pallet. For many items (e.g. 175-mm ammunition) this is a normal condition, and the block would be marked. For items never stored without a shipping container (e.g. 5.56-mm rifle ammunition) leave this block and the one under (h) blank.

Column (h) indicates storage without a shipping container so that the item is lying in direct contact with the ground. This block should be marked if there is a possibility of this situation occurring, as this is a critical storage condition from the standpoint of heat and dust. See also comments under (j).

Column (i) specified exposure in the shipping container during the "Ammunition Supply Point Subtest". If the item has a shipping container, this block should be marked.

Column (j) indicates exposure without a shipping container during the relatively short "Ammunition Supply Point" subtest. If the item will always be in a shipping container until issued to the user (e.g. 7.62-mm machine gun ammunition) this column should be left blank. If there way any question on marking column (h), this box (column (j)) should be marked.

Columns (k) through (p) refer to tactical movement over the three main types of desert (sandy, gravelly, and rocky or stony). At least one block should be left blank under each type. If testing criteria specified "intermediate hot-dry climate" as opposed to "extreme hot-dry climate", both sandy desert blocks ("k" and "l") may be left blank. The sandy deserts (e.g. the Lybian and Sahara) mainly fall within the "extreme" classification.

CAUTION: Do not base transportation requirements on the location of ultimate use. Although an item may not be used in, say, a sandy desert (e.g. cratering demolitions, railway mines, etc.) they may be transported across that desert. This is especially true of special forces items, or materiel used by raiding parties (e.g. Long Range Desert Group operations).

Columns (k), (m) and (o) refer to items normally carried in their shipping containers at this point. Other items (e.g. tank ammunition) are usually carried in racks or bins. If the former is true, mark the blocks. If there is any doubt, mark the blocks.

Columns (l), (n) and (p) are for items normally carried loose or in racks. Unless the item is always carried in its shipping container until immediately prior to firing or emplacement, mark these blocks.

Example 1

Test an XM884 cartridge, for Howitzer, 105-mm, M102 and M108, for compliance with AR 70-38. Item will be required to perform under all extremes of environment. (The XM884 is a complete round, to be used with both towed and self-propelled artillery. It is shipped four rounds to a box, with each

round individually packed in a fiber container.)

Queries to the Artillery Board and Artillery School indicate:

a. The item is not palletized for shipment.
b. The item is usually palletized for storage (but they don't think it really has to be).
c. The item is not taken from its fiber container (although the cap may be removed or loosened) until immediately before firing, or mounting in racks when used with a self-propelled weapon.
d. Extra rounds may be carried loose in their individual containers.

Figure A-2 shows the tabular headings for this example.

Scheduling Table - Exposure Tests (6.2.3)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
			Field Transport		Pre-stocked Supply Point				Ammo Supply Point		Tactical Movement					
					Container		Exposed				Mud Desert		Gravel Desert		Rock Desert	
	Road Transport	Fwd Depot Storage	w/overpack	wo/overpack	Pallet	Ground	Pallet	Ground	Container	Exposed	Container	Exposed	Container	Exposed	Container	Exposed
I			☑	☑	☑	☑	☐	☐	☑	☐	☑	☑	☑	☑	☑	☑
1	X	X	X	-	-	-	-	-	X	-	X	-	-	-	-	-
2	X	X	X	-	-	-	-	-	X	-	-	-	X	-	-	-
3	X	X	X	-	-	-	-	-	X	-	-	-	-	-	X	-
4	X	X	X	-	-	-	-	-	-	X	-	X	-	-	-	-
5	X	X	X	-	-	-	-	-	-	X	-	-	-	X	-	-
6	X	X	X	-	-	-	-	-	-	X	-	-	-	-	-	X
7	X	X	X	-	X	-	-	-	-	-	X	-	-	-	-	-
8	X	X	X	-	X	-	-	-	-	-	-	X	-	-	-	-
9	X	X	X	-	X	-	-	-	-	-	-	-	X	-	-	-
10	X	X	X	-	X	-	-	-	-	-	-	-	-	X	-	-

Figure A-2. Tabular Headings of Scheduling Table for Example No. 1

Example 2

Test an XM776 fuze for compliance with AR 70-38. Item will be required to perform under all extremes of environment (the XM776 fuze is a special proximity fuze, developed to supplement the M676 fuze). Both fuzes are normally used with the M650 series of cartridges (105-mm and 155-mm). The XM776 fuze is packed in a specially designed plastic container. Six fuzes and their individual containers are shipped in an aluminum mesh box. 10 -mm rounds will be used for functioning.

Doctrine indicates that:

a. Items usually accompany ammunition between the Ammunition Supply Point and the using battery.

b. Items are kept in their individual containers until assembled to the round. The replaced M676 fuze is returned to the container; shipping boxes are usually full. Extra boxes are carried under the loader's seat.

Figure A-3 shows the tabular headings for this example.

Scheduling Table - Exposure Tests (6.2.3)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
			Field Transport		Pre-stocked Supply Point				Ammo Supply Point		Tactical Movement					
					Container		Exposed				Mud Desert		Gravel Desert		Rock Desert	
	Road Transport	Fwd Depot Storage	w/overpack	wo/overpack	Pallet	Ground	Pallet	Ground	Container	Exposed	Container	Exposed	Container	Exposed	Container	Exposed
I	▨	▨	☑	☐	☑	☑	☐	☐	☑	☐	☑	☐	☑	☐	☑	☐
1	X	X	X	-	-	-	-	-	X	-	X	-	-	-	-	-
2	X	X	X	-	-	-	-	-	X	-	-	-	X	-	-	-
3	X	X	X	-	-	-	-	-	X	-	-	-	-	-	X	-
4	X	X	X	-	-	-	-	-	-	X	-	X	-	-	-	-
5	X	X	X	-	-	-	-	-	-	X	-	-	-	X	-	-
6	X	X	X	-	-	-	-	-	-	X	-	-	-	-	-	X
7	X	X	X	-	X	-	-	-	-	-	X	-	-	-	-	-
8	X	X	X	-	X	-	-	-	-	-	-	X	-	-	-	-
9	X	X	X	-	X	-	-	-	-	-	-	-	X	-	-	-
10	X	X	X	-	X	-	-	-	-	-	-	-	-	X	-	-
11	X	X	X	-	X	-	-	-	-	-	-	-	-	-	X	-
12	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	X
13	X	X	X	-	-	X	-	-	-	-	X	-	-	-	-	-
14	X	X	X	-	-	X	-	-	-	-	-	X	-	-	-	-
15	X	X	X	-	-	X	-	-	-	-	-	-	X	-	-	-
16	X	X	X	-	-	X	-	-	-	-	-	-	-	X	-	-
17	X	X	X	-	-	X	-	-	-	-	-	-	-	-	X	-
18	X	X	X	-	-	X	-	-	-	-	-	-	-	-	-	X
19	X	X	X	-	-	-	X	-	-	-	-	X	-	-	-	-
20	X	X	X	-	-	-	X	-	-	-	-	-	-	X	-	-
21	X	X	X	-	-	-	X	-	-	-	-	-	-	-	-	X
22	X	X	X	-	-	-	-	X	-	-	-	X	-	-	-	-
23	X	X	X	-	-	-	-	X	-	-	-	-	-	X	-	-
24	X	X	X	-	-	-	-	X	-	-	-	-	-	-	-	X
25	X	X	-	X	X	-	-	-	-	-	X	-	-	-	-	-

Figure A-3. Tabular Headings of Scheduling Table for Example No. 2

3.2 DETERMINATION OF SAMPLE SIZES

Once the tabular headings have been annotated to reflect the individual test requirements, determining the number of test samples is relatively easy.

The first step is to draw a vertical line through the columns which have not been checked (see Figure A-4, Step 1).

Scheduling Table - Exposure Tests (6.2.3)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
	Road Transport	Fld Depot Storage	Field Transport		Pre-stocked Supply Point				Ammo Supply Point		Tactical Transport					
					Container		Exposed				Sand Desert		Gravel Desert		Rock Desert	
			w/overpack	w/o/overpack	Pallet	Ground	Pallet	Ground	Container	Exposed	Container	Exposed	Container	Exposed	Container	Exposed
1			☑	☑	☑	☑	☐	☐	☑	☐	☑	☑	☑	☑	☑	☑
1	X	X	-	-	-	-	-	-	X	-	X	-	-	-	-	-
2	X	X	X	-	-	-	-	-	X	-	-	-	X	-	-	-
3	X	X	X	-	-	-	-	-	X	-	-	-	-	-	X	-
4	X	X	X	-	-	-	-	-	-	X	-	X	-	-	-	-
5	X	X	X	-	-	-	-	-	-	X	-	-	-	X	-	-
6	X	X	X	-	-	-	-	-	-	X	-	-	-	-	-	X
7	X	X	X	-	X	-	-	-	-	-	X	-	-	-	-	-
8	X	X	X	-	X	-	-	-	-	-	-	X	-	-	-	-
9	X	X	X	-	X	-	-	-	-	-	-	-	X	-	-	-
10	X	X	X	-	X	-	-	-	-	-	-	-	-	X	-	-
11	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-
12	X	X	X	-	X	-	-	-	-	-	-	-	-	-	-	X
13	X	X	X	-	-	X	-	-	-	-	X	-	-	-	-	-
14	X	X	X	-	-	X	-	-	-	-	-	X	-	-	-	-
15	X	X	X	-	-	X	-	-	-	-	-	-	X	-	-	-
16	X	X	X	-	-	X	-	-	-	-	-	-	-	X	-	-
17	X	X	X	-	-	X	-	-	-	-	-	-	-	-	X	-
18	X	X	X	-	-	X	-	-	-	-	-	-	-	-	-	X
19	X	X	X	-	-	-	X	-	-	-	-	X	-	-	-	-
20	X	X	X	-	-	-	X	-	-	-	-	-	-	X	-	-

Figure A-4. Portion of Scheduling Table Showing Elimination of Non-applicable Test Lots

Where the vertical line crosses an "X", draw a horizontal line across the table, crossing out that line (see Figure A-4, Step 2).

When you have finished these two steps, your table will show the required tests and sample units for the particular test. The required tests are those marked. Figure A-5 shows a table completed for Example 1 above.

Count the number of lines remaining from line 1 through line 48. (In the example, Figure A-5, there are 30 lines left.) This number equals the total number of test sample units (S) required for the test.

From Table A-1 determine the number of individual test items (n) for each test sample unit (s). The table gives both the minimum sample size (column b) and the desirable sample size (columns c through k). The desirable sample size is based on the desired minimum reliability factors and confidence

SCHEDULING TABLE - EXPOSURE TESTS (6.2.3)

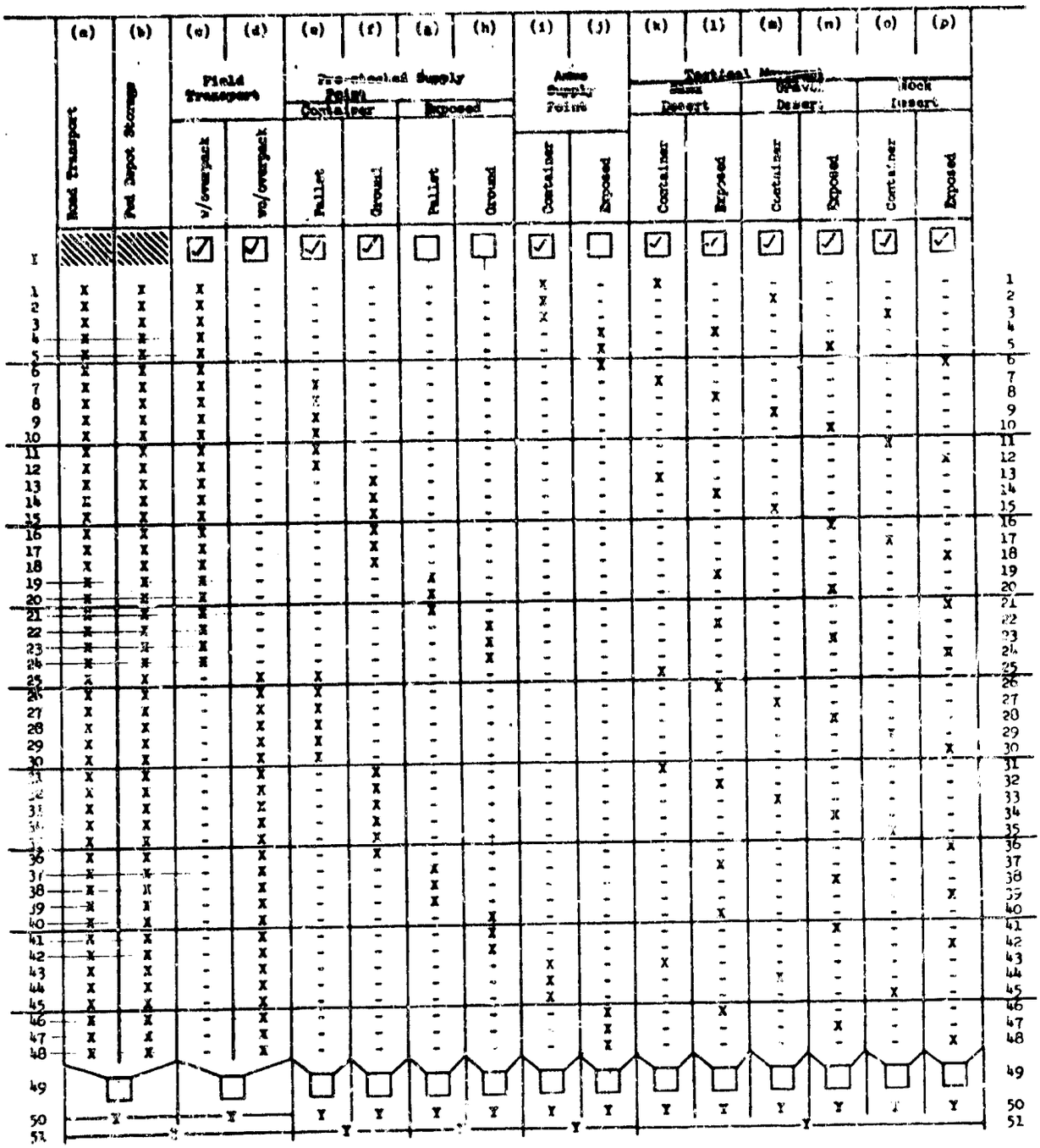

FIGURE A-5. Scheduling Table Based on Example No. 1

level (zero failures or defectives) as stated in the directive or QMR. If required reliability and confidence values are unknown, assume 80 percent reliability with a 95 percent confidence level (column g).

CAUTION: These factors are based on testing economics as well as statistical theory. Before evaluating results, read paragraph 3.5.2.

The total number of test items required (ΣS) is determined by multiplying the number of test sample units (s) by the number of test items in a sample unit (n). If the total number of test items is less than the number specified in Table A-II, increase n until the total number equals or exceeds the minimum required.

3.3 CONTROL SAMPLE REQUIREMENTS

Proper utilization of control items will enhance the value of any test. Where many factors influence the test, as in environmental field testing, their use is mandatory. Control samples serve two purposes:

a. Provide comparison data for evaluation of the degradation effects of the environment.

TABLE A-I. Number of Test Items in Each Test Sample Unit (Minimum and Desirable) based on Zero Failures or Defectives

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
		Confidence Level*								
Class		90%			95%			99%		
of	Min	Relia, Factor*			Relia, Factor*			Relia, Factor*		
Item	No.	75%	80%	90%	75%	80%	90%	75%	80%	90%
Projectiles and associated components:										
Up to 20-mm	20	25	35	80	30	45	90	50	65	180
20-mm - 40-mm	5	8	11	22	11	15	30	17	21	44
40-mm - 110-mm	3	4	5	13	5	7	15	8	10	18
110-mm - 160 mm	2	2	3	6	3	4	8	4	5	9
Over 160-mm	1	1	2	3	2	2	4	2	3	5
Explosives, Mines, Pyrotechnics, etc:										
Up to 2 lb	5	8	11	36	11	15	30	17	21	36
2 lb - 5 lb	3	4	5	13	5	7	15	8	10	18
5 lb - 25 lb	2	2	3	6	3	4	8	4	5	9
Over 25 lb	1	1	2	3	2	2	4	2	3	5

*If reliability factor or confidence levels are not specified, assume 80 percent reliability at a 95 percent confidence level (column g).

TABLE A-II. Minimum Number of Total Test Samples Required

Class of Item		Minimum Number of
Type	Caliber or Weight	Test Items (NS) Required
Projectiles and associated components	Up to 20-mm	500
	20-mm - 40-mm	300
	40-mm - 110-mm	50
	110-mm - 160-mm	30
	Over 160-mm	20
Explosives, Mines, Pyrotechnics, etc.	Up to 2 lb	100
	2 lb - 5 lb	50
	5 lb - 25 lb	30
	Over 25 lb	20

b. Isolate area of failure.

Due to the high cost of the items being tested, economy would apparently dictate reduction or elimination of control items. This is especially true when tests under environmental extremes are compared to tests in a temperate climate. In this situation, the latter items become "control" items. This approach does not, however, allow for one crucial environment. This is the "shipping environment" the test items experience between the manufacturer and the test agency. Unless provision is made to isolate this environment, any comparisons between tests at various agencies is invalid. It is mandatory that control items be allocated for this purpose.

In the same vein, the cost of the testing item is only one of the factors of the cost of a test. This fact must be considered if the optimum benefit is to be derived from field tests. Let us look, therefore, at the advantages of being able to isolate the various environments. These advantages are:

a. Identification of area requiring further testing. This introduces an economy in that extensive testing of non-essential areas will not be required, while the test manager will have some degree of confidence that such areas are non-essential.

b. Data will be available for corrective action. Corrective action can include redesign, modification, or lowering of operational criteria or limits.

c. Decisions for corrective action will be simplified and justified. With the above ideas in mind, it will be seen that control samples are required. It will also be seen that control samples should be integrated into the test plan to provide the maximum data consistent with test economics. The problem is, then, how many control samples and where are they used.

Again, the use of the Scheduling Table (Figure A-6) will solve this problem. At this point, nonapplicable tests have already been eliminated. All that remains is for the planner to determine how many control units (c) are required, and the number of (n) of items in each of these units.

Control samples and their use are described in this Appendix and MTP. The number of control samples and their size are determined as described below. As stated in the above reference, these items will be exposed only to one group or one single subtest exposure mode. For the remainder of the test (until functioning) they will be stored in isothermic (70° ± 5°F) conditions.

Figure A-6 shows the applicable parts of the Scheduling Table, (Figure 1), as marked for Example 2 (Para. 3.1, this appendix). Line 49 consists of a series of blocks. Each block represents an element which may be isolated by control samples.

Extend the vertical lines you have drawn previously down through lines 49 and 50. If both Y's in a group (e.g., columns g and h) are eliminated on line 50, cross out the Y immediately below on line 51 (Fig. A-, Note 1).

The test designer now has a choice between two control plans. Line 50 represents the "desirable" plan, and line 51 the "minimum" or "austere" plan. If the total number of test samples (ΣS) equals 50 or more, line 51 should be used. If ΣS is less than 10, line 50 should be used. If the minimum plan (line 51) is used, controls should be subjected to the most severe exposure within their area. If there is any doubt as to severity, additional control groups should be used.

Total the number of control groups. This number, PLUS ONE, is the total number of test control groups (C).

From Table A-III, determine the number of individual test items (n) for each test control group.

TABLE A-III. Minimum Number of Test Items Required for Each Test Control Group

Class of Item		Minimum Number of
Type	Caliber of Weight	Test Items Required
Projectiles and associated components	Up to 20-mm	100
	20-mm - 40-mm	30
	40-mm - 110-mm	20
	110-mm - 160-mm	10
	Over 160-mm	5
Explosives, Mines, Pyrotechnics, etc.	Up to 2 lb	30
	2 lb - 5 lb	20
	5 lb - 25 lb	10
	Over 25 lb	5

SCHEDULING TABLE - EXPOSURE TESTS (6.2.3)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
			Field Transport		Pre-stocked Supply Point				Ammo Supply Point		Tactical Movement						
					Container		Exposed				Sand Desert		Gravel Desert		Rock Desert		
	Road Transport	Fwd Depot Storage	w/overpack	wo/overpack	Pallet	Ground	Pallet	Ground	Container	Exposed	Container	Exposed	Container	Exposed	Container	Exposed	
I			☑	☐	☑	☑	☐	☐	☑	☐	☑	☐	☑	☐	☑	☐	
1	X	X	X	-	-	-	+	+	X	+	X	-	-	-	-	-	1
2	X	X	X	-	-	-	+	+	X	+	-	-	X	-	-	-	2
3	X	X	X	-	-	-	+	+	X	+	-	-	-	-	X	-	3
4	X	X	X	-	-	-	+	+	-	X	-	X	-	-	-	-	4
5	X	X	X	-	-	-	+	+	-	X	-	-	-	X	-	-	5
6	X	X	X	-	-	-	+	+	-	X	-	-	-	-	-	X	6
7	X	X	X	-	X	-	+	+	-	+	X	-	-	-	-	-	7
8	X	X	X	-	X	-	+	+	-	+	-	X	-	-	-	-	8
9	X	X	X	-	X	-	+	+	-	+	-	-	X	-	-	-	9
10	X	X	X	-	X	-	+	+	-	+	-	-	-	X	-	-	10
11	X	X	X	+	X	-	+	+	-	+	-	-	-	-	X	-	11
12	X	X	X	+	X	-	+	+	-	+	-	-	-	-	-	X	12
13	X	X	X	+	-	X	+	+	-	+	X	-	-	-	-	-	13
14	X	X	X	+	-	X	+	+	-	+	-	X	-	-	-	-	14
15	X	X	X	+	-	X	+	+	-	+	-	-	X	-	-	-	15
16	X	X	X	-	-	X	+	+	-	+	-	-	-	X	-	-	16
17	X	X	X	+	-	X	+	+	-	+	-	-	-	-	X	-	17
18	X	X	X	+	-	X	+	+	-	+	-	-	-	-	-	X	18
19	X	X	X	+	-	-	X	+	-	+	-	X	-	-	-	-	19
20	X	X	X	+	-	-	X	+	-	+	-	-	-	X	-	-	20
21	X		X	-	-	-	X	+	-	+	-	-	-	-	-	X	21
22	X	X	X	-	-	-	+	X	-	+	-	X	-	-	-	-	22
23	X	X	X	-	-	-	+	X	-	+	-	-	-	X	-	-	23
24	X	X	X	-	-	-	+	X	-	+	-	-	-	-	-	X	24
25	X	X	-	X	X	-	+	+	-	+	X	-	-	-	-	-	25
26	X	X	-	X	X	-	+	+	-	+	-	X	-	-	-	-	26
27	X	X	-	X	X	-	+	+	-	+	-	-	X	-	-	-	27
28	X	X	-	X	X	-	+	+	-	+	-	-	-	X	-	-	28
29	X	X	-	X	X	-	+	+	-	+	-	-	-	-	X	-	29
30	X	X	-	X	X	-	+	+	-	+	-	-	-	-	-	X	30
31	X	X	-	X	-	X	+	+	-	+	X	-	-	-	-	-	31
32	X	X	-	X	-	X	+	+	-	+	-	X	-	-	-	-	32
33	X	X	-	X	-	X	+	+	-	+	-	-	X	-	-	-	33
34	X	X	-	X	-	X	+	+	-	+	-	-	-	X	-	-	34
35	X	X	-	X	-	X	+	+	-	+	-	-	-	-	X	-	35
36	X	X	-	X	-	X	+	+	-	+	-	-	-	-	-	X	36
37	X	X	-	X	-	-	X	+	-	+	-	X	-	-	-	-	37
38	X	X	-	X	-	-	X	+	-	+	-	-	-	X	-	-	38
39	X	X	-	X	-	-	X	+	-	+	-	-	-	-	-	X	39
40	X	X	-	X	-	-	+	X	-	+	-	X	-	-	-	-	40
41	X	X	-	X	-	-	+	X	-	+	-	-	-	X	-	-	41
42	X	X	-	X	-	-	+	X	-	+	-	-	-	-	-	X	42
43	X	X	-	X	-	-	+	+	X	+	X	-	-	-	-	-	43
44	X	X	-	X	-	-	+	+	X	+	-	-	X	-	-	-	44
45	X	X	-	X	-	-	+	+	X	+	-	-	-	-	X	-	45
46	X	X	-	X	-	-	+	+	-	X	-	X	-	-	-	-	46
47	X	X	-	X	-	-	+	+	-	X	-	-	-	X	-	-	47
48	X	X	-	X	-	-	+	+	-	X	-	-	-	-	-	X	48
49																	49
50	X		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	50
51	Y				Y		Y		Y		Y						51

Note 1 (see text)

FIGURE A-6. Sample Entry on Scheduling Table to Determine Control Requirements (See Example 2)

The total number of test controls required (ΣC) is determined by multiplying the number of test control units (C) by the number of control samples per unit (n).

3.4 SAMPLE IDENTIFICATION AND CONTROL

Proper sample identification is a major factor in reducing error during testing and facilitating control. If the identification system is correlated with the Scheduling Table (Figure A-7), it will also serve to relieve successive test personnel of the difficulties of test control, and recovery and analyzing data.

The following procedure will simplify this operation. Example 1 is used to demonstrate this procedure. A completed table for Example 1 is shown in Figure A-7.

Quantities required are:

$$\Sigma S = Sn = (30)\ (3) = 90$$
$$\Sigma C = Cn = (5 + 1)\ 20 = \underline{120}$$
$$210$$

Note that there are three samples (the minimum) in each test lot. Figure A-8 shows a partial work sheet layout for these items. Part 1 is for test samples, Part 2 is for control samples. The column headings in Part 1 (one) are based on the test sample number, the margin leads (two) on the line number for the figure. The headings in Part 2 (three) are based on the control column headings (Figure A-7) (note the addition of a control group for the complete test minus functionability (four). The margin leads in the second part are based on the control sample number (five). (Relative position is unimportant, as long as number of sample is compared to its respective lot number.)

Once the headings and margins are identified, the remaining steps are easy. Enter a designator for each item (six). This designator consists of, first, the lot descriptor (seven), and second, the individual sample number within that lot (eight).

Next, note these designators with the sample number, picked from a random number table (nine). These same numbers are assigned to randomly selected test items. The test items may be marked with either the designator, the number, or both.

3.5 EVALUATION OF DATA

The final use of the scheduling table is the evaluation of data. Evaluation includes isolation of failures, and the statistical evaluation of failures. The first step to evaluation of data is the marking of test data on the Scheduling Table (Figure 1). Failures during exposure testing are marked where they occur. Functioning failures are marked in the right margin, on the same line where they fail.

SCHEDULING TABLE - EXPOSURE TESTS (4.2.3)

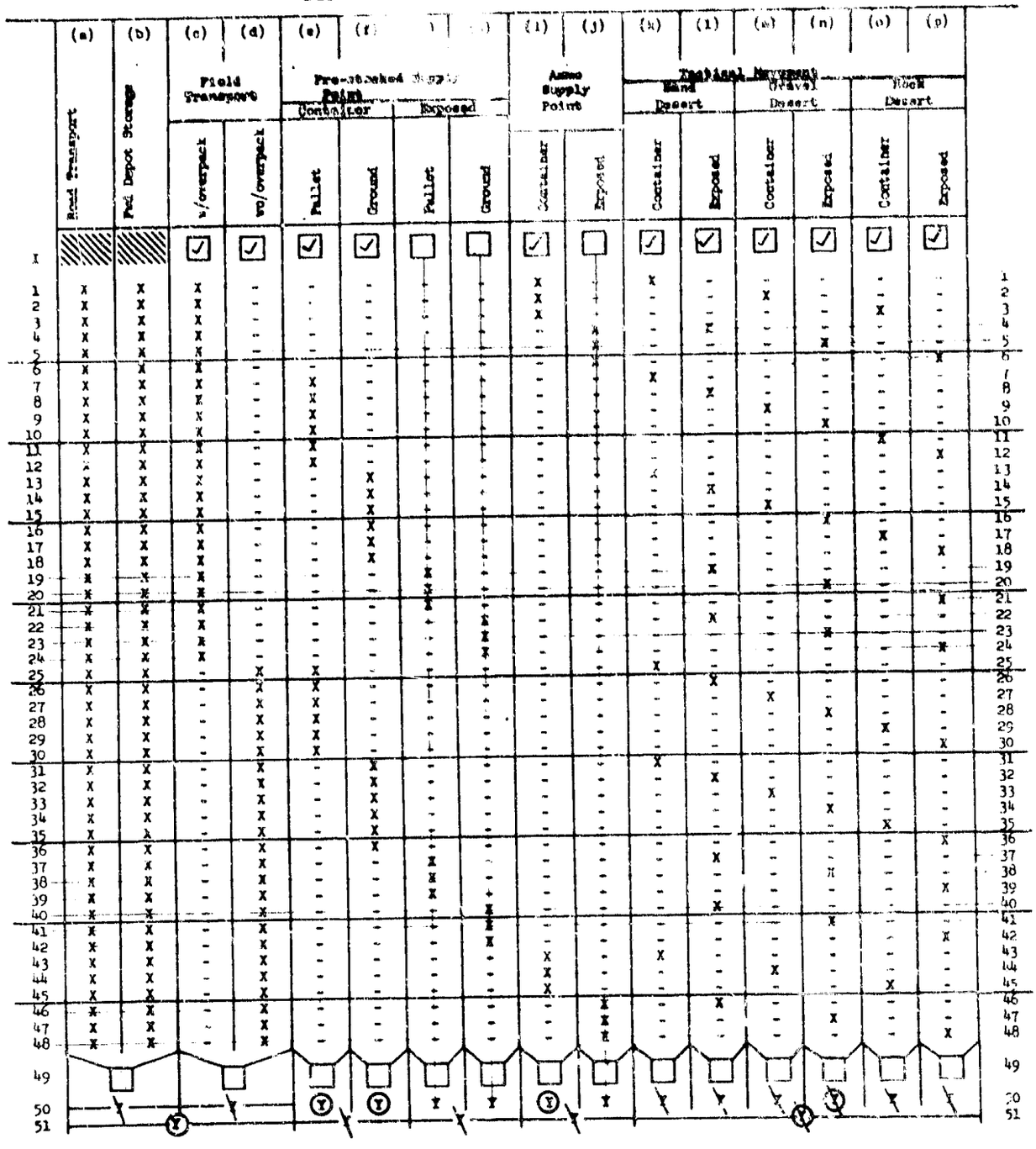

FIGURE A-7. Scheduling Table for Example 1 (Modified)

FIGURE A-8. Partial Worksheet for Sample Identification

Part 1 - Test Samples

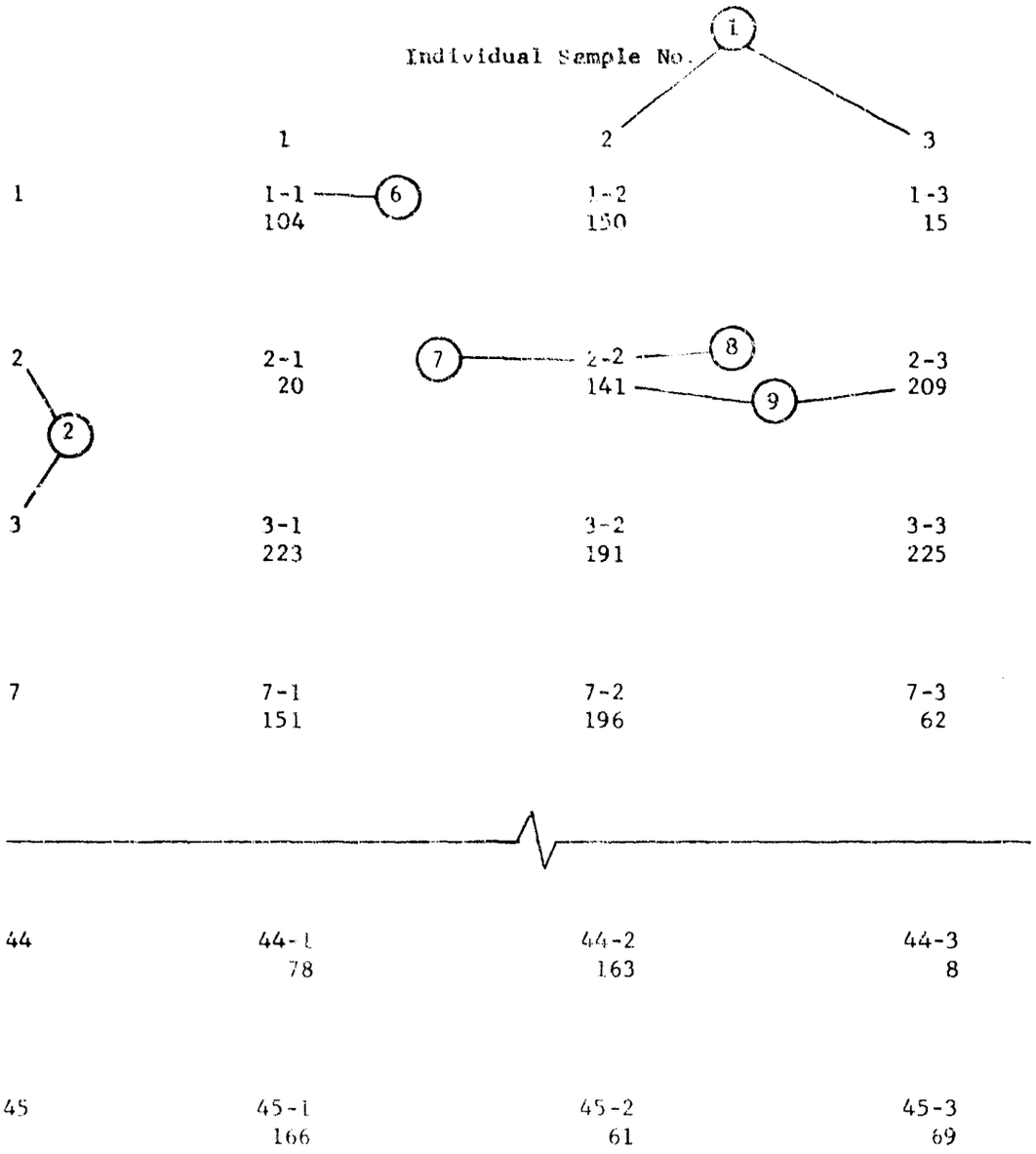

FIGURE A-8. Partial Worksheet for Sample Identification (Cont'd)

Part 2 - Control Samples

Sample Lot Column

	Test Control -,	a	e	f	i	n
1	TC-1 12	a-1 110	e-1 186	f-1 219	i-1 210	n-1 7
2	TC-2 13	a-2 83	e-2 2	f-2 94	i-2 156	n-2 101
3	TC-3 111	a-3 177	e-3 134	f-3 97	i-3 85	n-3 146
4	TC-4 156	a-4 104	e-4 171	f-4 200	i-4 184	n-4 57
19	TC-19 139	a-19 74	e-19 203	f-19 154	i-19 54	n-19 183
20	TC-20 142	a-20 18	e-20 99	f-20 137	i-20 197	n-20 107

NOTE: Circled numbers refer to text, Paragraph 3.4

3.5.1 Isolation of Failures

Blocked factorial experiments (such as set up in Figure 1, Scheduling Table) are readily analyzed for main effects and interactions. A detailed, systematic analysis may be employed, but considerable data can be derived from visual examination.

As an example, consider Figure A-9. This is an abbreviated schedule, similar to Scheduling Table (Figure 1). Deficiencies were based on functioning performance. In this case, no failures were detected during the exposure tests (A, B, and C). Each sample lot consisted of five items, each control lot of 20.

FIGURE A-9. Example of a Schedule Marked for Evaluation

	Exposure					
	A		B		C	
Sample Lot	Mode 1	Mode 2	Mode 1	Mode 2	Mode 1	Firing
1	X(3)		X(3)			3
2	X(0)			X(0)		0
3	X(0)				X(0)	0
4		X(2)	X(2)			2
5		X(0)		X(0)		0
6		X(2)			X(2)	2
C1	X(3)					3
C2		X(5)				5
C3			X(7)			7
C4				X(0)		0
C5					X(0)	0
C Test						0

Note the deficiencies detected for each lot are carried across to each mode to which that lot was exposed. Do not attempt to assign any deficiencies to one mode. This is true if a deficiency is noted during testing - it must be picked up for each previous mode to which it was exposed prior to detection. FAILURES MAY BE CAUSED BY A COMBINATION OF FACTORS AS WELL AS A SINGLE FACTOR.

TABLE A-IV. Deficiencies Based on Exposure Modes (From Fig. A-9)

Exposure Mode	Test Samples		Control Samples	
	Deficiencies	Fraction	Deficiencies	Fraction
A1	3	0.20	3	0.15
A2	4	0.27	5	0.25

TABLE A-IV (Cont'd)

Exposure Mode	Test Samples		Control Samples	
	Deficiencies	Fraction	Deficiencies	Fraction
B1	5	0.33	7	0.35
B2	0	0	0	0
C1	2	0.13	0	0
Firing	7	0.23	0	0

The deficiencies noted in Figure A-9 may be summarized by exposure mode. Total deficiencies for each mode, and the fraction these deficiencies represent, are extracted in Table A-IV. For the purpose of isolating failure causes, test samples and control samples are treated independently.

Certain conclusions may be drawn from inspection of data in Figure A-9 and Table A-IV:

a. All the test controls subjected only to firing functioned satisfactorily. Therefore, deficiencies in functioning are due to a combination of exposure and firing, and not firing alone.

b. Exposure Mode B2 appears to have little effect on functioning, alone or in combination with other factors.

c. Exposure Mode C1 appears to have effect on functioning only in combination with other factors.

d. Exposure Modes A2 and B1 appear critical when considered alone.

e. Exposure Mode A1 appears critical when considered in conjunction with other exposures.

f. Further testing might be justified on the combinations A1, B1; A1; A2, B1; and B1.

g. Recommendations should include avoiding Exposure Mode B1 during operational use.

3.5.2 Statistical Evaluation of Data

The material in this section, and the Scheduling Table (Figure 1) is based on factorial experiment design (Reference L, Chapter 12). Modifications have been introduced due to the demands of test economics. Because of these modifications, the following material is included.

Statistical evaluation of the data from the tests in this Appendix requires assistance from experienced mathematicians and statisticians. The proper designation of sample sizes has a major effect on the validity of the test. Of course, measured variable data requires less sample size than attribute (go - no go) data, under the same conditions of confidence levels and desired minimum reliability. This is best exemplified by consideration of the effect of sample size on results. As an example, consider the effect one failure has on different lot sizes. Table A-I gives the following sample sizes for a test of 3.2 lb runway flare: 3 (minimum), 5, 7, and [illegible] the latter three for

a 95 percent). Table A-V shows the confidence limits based on one failure of these sample sizes (from Reference N, Table A-22).

TABLE A-V. Effect of Sample Size on Confidence Limits (One Failure)

Sample Size	Confidence Levels		
	90%	95%	99%
3	0.035 - 0.804	0.017 - 0.865	0.003 - 0.941
5	0.021 - 0.621	0.010 - 0.657	0.002 - 0.778
7	0.015 - 0.500	0.007 - 0.554	0.001 - 0.643
15	0.007 - 0.247	0.003 - 0.302	0.001 - 0.373

Obviously, increasing the size of your sample tightens your confidence intervals in reporting. The problem of large sample sizes has already been mentioned. One of the benefits of the sampling plan presented in this Appendix is the ability to accumulate samples exposed to the same environment. It must be emphasized that the random sampling discussed in this Appendix is mandatory if this benefit is to be exploited, that is, every sample unit must have an equal probability of being chosen as part of the sample.

The process of accumulating samples is demonstrated in Table A-V. The resulting tightening of confidence limits is equivalent in effect to increasing sample size. The importance of this procedure need hardly be emphasized to the cost conscious test designer.

The data in Table A-VI is based on attribute type of data in the example shown in Figure A-9 and Table A-IV. Two exposure modes are considered purely for the purpose of illustration. Confidence limits are based on a 95 percent confidence level. The technique can be applied to any blocked factorial design including the Scheduling Table in Figure 1, when variable data methods are appropriate.

TABLE A-VI. Example of Effect of Combining Lot Results

Exposure Mode	Lots Considered	No. of Samples	No. of Defectives	Fraction Defectives	Confidence Limits
A2	1	5	2	0.400	0.076 - 0.811
	1, 2, 3	15	4	0.267	0.097 - 0.522
	1, 2, 3, C1	35	5	0.143	0.06 - 0.31
B2	2	5	0	0.000	0 - 0.500
	2, 5	10	0	0.000	0 - 0.267
	2, 5, C6	30	0	0.000	0 - 0.100

In following this procedure, a point of caution should be noted. Consideration of a single lot is based on the effects of the test on that lot. By combining lots, the emphasis is placed on the effect of a single exposure

mode on the test item. This is desirable, but care should be taken that the significance of this change of emphasis, and its technique, are understood. Caution should also be exercised in the manner in which these computations are reported. All calculations of this nature, which are the basis for conclusions, should be verified by a qualified statistician.

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APPENDIX B

INSPECTION REQUIREMENTS

(a) Type Inspection	(b) Code	(c) Failures Description	(d) Initial (Para. 6.2.1)	(e) After Exposure Mode	(f) Before Functioning
		Table 1 - Overpack			
		(Deficiency)			
Visual	1201	Box damage, exposing contents	X	X	-
Visual	1202	Board broken or loose	X	X	-
Visual	1203	DOD symbol missing or incorrect	X	-	-
Visual/Manual	1204	Hardware or strap missing, broken, or loose	X	X	-
		(Shortcoming)			
Visual	1301	Marking misleading or illegible	X	X	-
Visual/Manual	1302	Hardware or strapping improperly engaged or mislocated	X	X	-
Visual/Manual	1303	Handle missing or insecure	X	X	-
		Table 2 - Individual Container			
		(Deficiency)			
Visual	2201	Packing components missing	X	-	-
Visual	2202	Container cut or broken, contents exposed	X	X	X
Visual	2203	Ends loose or distorted	X	X	X
Visual	2204	Seals incomplete, broken, or wrinkled	X	X	X
		(Shortcoming)			
Manual	2301	Contents loose	X	X	X
Visual	2302	Markings misleading or illegible	X	X	X
Visual	2303	Cuts, scuffs or gouges in outer layers	X	X	X
Manual	2304	Tear tab length inadequate	X	-	-

(a) Type Inspection	(b) Code	(c) Failure Description	(d) Initial (Para. 6.2.1)	(e) After Exposure Mode	(f) Before Functioning
Visual	2305	Cap between cover and body greater than 1/8 inch	X	-	X
Manual	2306	Cap cannot be removed by hand	X	-	X
Manual	2307	Item cannot be removed by hand	X	-	X
Visual	2308	Item improperly assembled in container	X	-	-
		Table 3 - Unassembled Parts			
		(Deficiency)			
Visual	3101	Excessive charge	X	-	-
Visual	3102	Charge damaged to discolored	X	X	X
Visual	3103	Foreign matter in fuze or primer cavity	X	X	X
Visual	3201	Charge missing	X	-	-
Visual	3202	Component missing	X	X	X
Visual	3203	Component damaged	X	X	X
Visual	3204	Component loose	X	X	X
	3205	...			
		(Shortcoming)			
Visual	3301	Evidence of poor workmanship	X	-	X
		Table 4 - Assembled Items			
		(Deficiency)			
Manual	4101	Primer above flush	X	X	X
Visual	4102	Shear or safety pin or wire missing	X	X	X
Visual	4103	Body or case split	X	X	X
Visual	4104	Excess propellant	X	-	-
Visual	4105	Warning label missing or illegible	X	X	X
Manual	4201	Primer loose	X	X	X
Torque	4202	Fuze fails torque test	X	-	X
Visual	4203	Propellant missing	X	X	X
Manual	4	Propellant or case insecurely attached	X	X	X
Visual	4205	Improperly assembled	X	-	-

(a)	(b)	(c)	(d)	(e)	(f)
Type Inspection	Code	Failures Description	Initial (Para. 6.2.1)	After Exposure Mode	Before Functioning
Visual	4206	Foreign material present which will cause malfunction	X	X	X
		(Shortcoming)			
Manual	4301	Fuze loose	X	X	X
Visual	4302	Fuze not staked	X	-	-
Visual	4303	Protective plugs missing	X	X	X
Visual/Manual	4304	Rotating band loose or damaged	X	X	X

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APPENDIX C

THE INFLUENCE OF TERRAIN ON THE DESERT ENVIRONMENTAL TESTING OF AMMUNITION AND EXPLOSIVES

1. EMPLACEMENT

The mechanics of soils, particularly desert soils, affecting emplaced munitions (e.g., antitank mines, demolitions, etc.) has not been fully explored. Certain parameters are known to have considerable effect on the functioning and effectiveness of emplaced munitions.

Compression (the volumn change produced by application of a static external load) and compaction (volume change produced artificially by momentary load application) have a significant effect on fuzing systems dependent on a load differential. They also contribute to the effectiveness of an igniting charge, by either directing and amplifying its force, or by partial absorption of its force.

Shearing strength (resistance to sliding of one mass of soil against another) and cohesion also contribute to the effectiveness of a fuzing system. Their primary effect is on the stability of the sides of excavated surfaces (craters, foxholes, etc.)

Particle distribution and density must also be considered when the volume that an explosive is to remove is a measure of effectiveness or must be determined.

Table C-I shows the more common desert surface conditions. Characteristics of test munitions which are influenced by each terrain type area are also indicated in Table C-I.

Due to the diversity of munitions which may be emplaced, the project planner must rely on judgement in designating functioning locations. Consideration should be given to both design use and expedient uses of a test item. For instance, cratering charges are normally employed to create obstacles. An important use in the desert, however, is to rapidly emplace weapons and vehicles (reference FM 31-25).

Surface types in Table C-I include description of the material, unified soil classification system symbol (see reference MIL-STD 619B) and typical occurrences. Location of test areas should be based on the material description.

2. FUNCTIONING

Terrain influences functioning in two basic respects. The first is the effect on ignition systems. The second is the contribution of the materiel to the lethality of the test team.

Fuzes set for surface and delay bursts may or may not function properly

TABLE C-I Desert Surface Types and Their Influence on Emplaced Munitions

Desert Types	Soil Group Description	Symbol	Typical Occurrence	Test Munitions Types: Land Mines, Pressure Actuation	Land Mines, Remote Actuation	Demolition Items, Cratering, Ditching	Demolition Items, Clearing, Quarrying
	Well graded sands, little or no fines	SW	Sand dunes	a, b	b	-	-
Sandy			Sand fields				
	Poorly graded sands, little or no fines	SP	Sand sheets	a, b	b	-	-
	Gravel, sand, and silt mixtures (poorly consolidated)		Desert plains Alluvial flats Fans and Bajadas	a, b, c	b, c	a, d	-
	Cobbles, gravels, sand & silt mixtures (consolidated)	GM	Bajadas	-	-	a, d	-
Gravelly	Gravel mosaic surface over a gravel, sand & silt mixture		Desert Pavement	a, b, c	b, c	a, c, d	-
	Gravel and sand mixtures with little or no fines	GP	Wash beds	a, c	c	d	-
Rocky	Rock surfaces, with boulder and cobble covering	--	Pediments	-	-	d	d
	Bare rock surfaces	-		-	-	-	d

NOTE: a. initiation; b. functioning; c. lethality; d. effectiveness

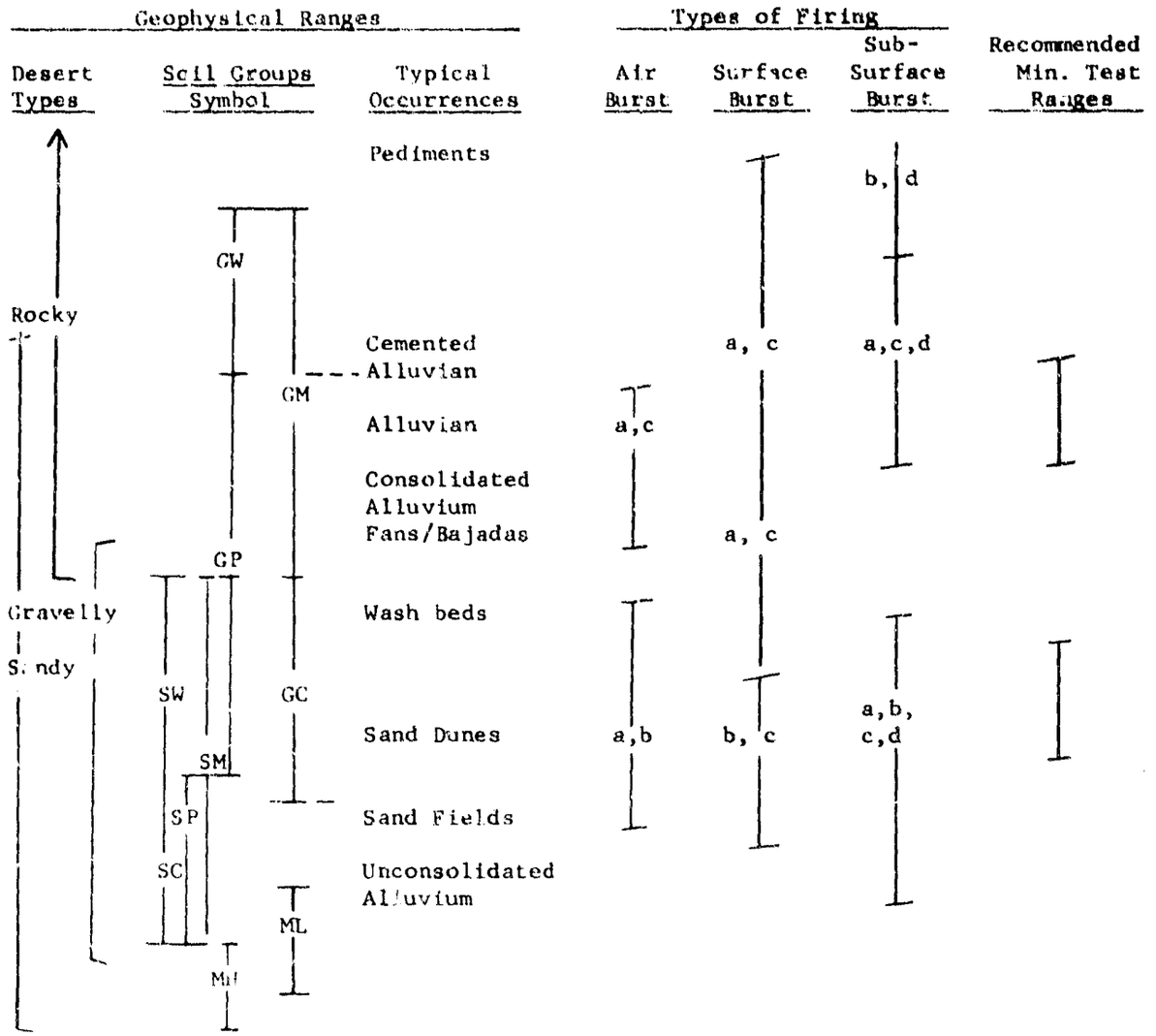
depending on the characteristics of the surface at impact. Unconsolidated soils may not provide enough resistance to function a fuze until relatively deep penetration is attained. On the other hand, rock surfaces or consolidated and highly cemented soils may resist any significant penetration.

This relative resistance to penetration is a result of the interaction of the same soil parameters that determine bearing strength. Thus, a measure of a soil's bearing strength can be assumed to approximate that soil's resistance to penetration. (One such measure of bearing strength is the California Bearing Ratio (CBR).)

Table C-II shows the ranges of various desert and soil types in relation to munition characteristics significantly affected. Also shown are the minimum functioning sites recommended for desert testing. The actual determination of required functioning sites will depend on the purpose and design of the test item.

CAUTION: The phenomena known as "desert pavement" can cause wide variations in the terminal effects of a munition. In its virgin state, the rock surface of "desert pavement" can be likened to boiler plate. Once penetrated or otherwise disturbed, the underlying strata will offer relatively low resistance to subsequent impact.

TABLE C-II Desert Surface Types and Their Influence on Terminal Performance of Projectiles



NOTE: a. initiation; b. functioning; c. lethality; d. effectiveness

APPENDIX D

POSURE CRITERIA FOR AMMUNITION SUPPLY POINT

(Based on a design goal at 3,780°F-hr above 90°F)

Air Temperature (°F)			Ground Temperature (°F)		
No. of Days	No. of Hr/Day	Min Temp	No. of Days	No. of Hr/Day	Min Temp
5	2	110	5	3	140
+10	4	105	+10	4	135
+19	3	100			
3	2	110	5	1	140
+15	4	105	+20	4	135
+13	3	100			
10	4	105	10	1	135
+30	3	100	+30	4	130

APPENDIX E

MILEAGE REQUIREMENTS FOR TACTICAL TRANSPORTATION TESTS

(See MTP-104-003 for discussion of desert types and components)

Type Munition	Light Tactical Vehicle Transport			Emplaced Munitions			Combat Vehicle Transport		
Type Desert	Stony	Gravelly	Sandy	Stony	Gravelly	Sandy	Stony	Gravelly	Sandy
Components									
Mountains	15	--	5	7	--	3	15	--	5
Badlands/hills	20	15	5	10	15	4	20	25	5
Fan/wash	15	15	-	8	15	-	15	25	-
Plains/flats	20	35	25	10	35	10	20	60	25
Dunes/fields	--	5	35	--	5	18	--	10	35
Dust	--	5	10	--	5	5	--	10	5
	70	75	80	35	75	40	70	130	75

APPENDIX F

MILEAGE REQUIREMENTS FOR TACTICAL TRANSPORTATION TESTS

(See MTP-10-1-003 for discussion of desert types and components)

Type Munition	Light Tactical Vehicle Transport			Emplaced Munitions			Combat Vehicle Transport		
Type Desert Components	Stony	Gravelly	Sandy	Stony	Gravelly	Sandy	Stony	Gravelly	Sandy
Mountains	15	--	5	7	--	3	15	--	5
Badlands/hills	20	15	[illegible]	10	15	4	20	25	5
Fan/wash	15	15	-	8	15	-	15	25	-
Plains/flats	20	35	25	10	35	10	20	60	25
Dunes/fields	--	5	35	--	5	18	--	10	35
Dust	--	5	10	--	5	5	--	10	5
	70	75	80	35	75	40	70	130	75

APPENDIX F

FUNCTIONING TESTS FOR ARTILLERY AMMUNITION

Functioning Test	Reference MTP	Test Items: Complete Rounds: Antipersonnel	Armor Defeating	Target Practice	Illumination	Chemical	High Explosive	Ammunition Components: Cases	Propellant	Projectiles	Fuzes
Seating	4-2-802	-	-	-	-	-	-	-	Xa	Xa	-
Chamber pressure	3-2-810	-	-	-	-	-	-	X	X	R	R
Muzzle velocity	4-2-805	X	X	X	X	X	X	X	X	X	Xa
Obturation	4-2-501	Ra	Ra	Ra	Ra	Ra	Ra	Ra	Ra	Ra	-
Metal Parts		a	a	a	a	a	a	-	a	a	Ra
Time of flight	4-2-805	a	a	a	a	a	a	-	-	a	a
Accuracy:											
Direct fire	4-2-829	X	Xa	Xa	Xa	Xa	Xa	-	Xa	Xa	-
Indirect fire	3-2-819	-	Xa	Xa	Xa	Xa	Xa	-	Xa	Xa	-
Order of function	4-1-003	-	Xa	-	-	-	X	-	-	-	X
Fuze time:											
Superquick	4-2-807	Xa	a	-	-	Xa	Xa	-	-	a	Xa
Air Burst	4-2-808	Xa	a	-	X	Xa	Xa	-	-	a	Xa

NOTE: X - all rounds
R - one round per lot
a - as applicable

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13. ABSTRACT

This Army Environmental Test Procedure describes the techniques for determining the capability of military ammunition and explosives to withstand all known conditions in the desert which might have significant effects on the performance characteristics of the ammunition. The desert environmental examination is part of the overall Environmental Test used for determining the suitability of ammunition and explosives for use by the U. S. Army. The methods are described in general terms for preparing, conducting, recording, and reporting desert environmental testing of ammunition and explosives, to include; artillery and small arms ammunition, ammunition components, demolition materiels, mines, pyrotechnics, and ignition systems.

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